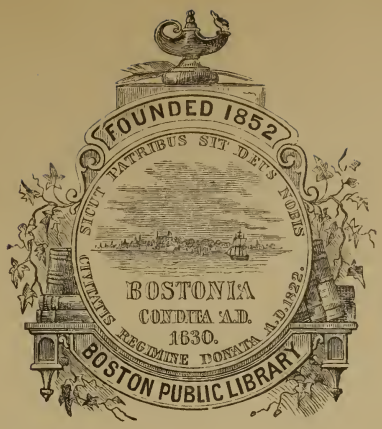

PAMPHLETS.

Maritime

Hon Mr. Mann

ERICSSON'S CALORIC ENGINE.

DESCRIPTION

OF THE

TRIAL EXCURSION

OF THE

CALORIC SHIP ERICSSON,

FROM

THE DAILY JOURNALS OF THE CITY OF NEW YORK.

GIDEON & Co., Printers.

ERICSSON'S CALORIC ENGINE.

ARTICLES

DESCRIPTIVE OF

THE CALORIC SHIP ERICSSON,

AND

OF HER TRIAL EXCURSION

OF JANUARY 12TH, 1853;

TAKEN FROM

THE DAILY JOURNALS

OF THE

CITY OF NEW YORK.

WASHINGTON:
GIDEON & CO., PRINTERS.
1853.

THE CALORIC ENGINE.

In reprinting from the New York Journals the annexed articles in relation to the Caloric Engine and its wonderful performances on the trial trip of the ERICSSON, we have only to say, that no invention has ever drawn forth a simultaneous and spontaneous expression from the public press so satisfactory and conclusive as is given in the following pages. It is evident from the concurrent testimony of these journals, and from the interest and enthusiasm which they manifest at the results they have witnessed, that the importance of the invention cannot be over-estimated, and that its success has been established by the most triumphant demonstration on record The work of the *inventor* is complete.

THE CALORIC SHIP ERICSSON.

From the Courier and Enquirer, Wednesday morning, January 12, 1853.

We give a large portion of our limited space to a detailed account of the Caloric ship *Ericsson*, and of the interesting proceedings which took place on board of her yesterday, during a trip which she made to the lower bay. It matters little whether this vessel went one mile or one hundred, or whether she was propelled at the rate of two miles an hour or twenty; the great facts to be established were, first, that an engine of considerable power could be driven by another, a better, cheaper, and safer motor than steam; and, second, that such an engine could be effectively used in a vessel of sufficient size to cope with the sea. These the trip of yesterday settled beyond a doubt or a cavil. But when we add to these that a sea steamer (for so we still call her) of first rate size was upon her second trial, made with unfinished engines, equal to only seven-twelfths of their power, very materially inferior in size to those designed for her by the inventor, propelled against tide and wind at the rate of nine or ten miles an hour, we record one of the most stupendous triumphs in science and mechanics which has ever claimed the admiration of the world.

No accurate or reliable description of the *Ericsson* and her engine has been published before this morning; none which could give the reader a just idea of the plan or working of the engine. Such could only be prepared by the aid of the inventor himself, and the minute account which we lay before our readers this morning is made up from information communicated to us by Captain Ericsson himself, and is published with the sanction of his authority.

The name given to this engine misleads the popular conception with regard to it. It is not a caloric engine, if that name imply that caloric is used as a motive power. It might be better termed an atmospheric gine, for it is upon the elasticity and expansiveness of the air that its action depends. Caloric is in no greater sense its motive power than it is that of the steam engine. It is the very air we breathe which propels that enormous vessel. The inventor has seized upon the viewless winds and compelled them to do his bidding; he has harnessed the steeds of the air to the car of commerce. He has by twenty years patient and thoughtful working and waiting, made the most impalpable and innocuous element of which our senses are cognizant, the mighty power which is to produce the most stupendous material effects which they can appreciate or the mind can project. He has diminished the danger of the traveller by sea, and ultimately by land of the mechanic, of the engineer, of all in fact who now incur the risks of steam, to an inappreciable entity, if he have not removed them altogether. Let the memory of the *Henry Clay* and the *Reindeer* sadden the heart but for a moment, and we shall then begin to appreciate one of the benefits which

Captain Ericsson has bestowed upon his kind. Let the merchant think of a vessel whose freight decks are open from stem to stern, and which is yet propelled with the consumption of six tons of coal in place of the fifty used by a sea steamer, and he can then justly consider one of the particular benefits which the inventor has conferred upon commerce. But the future opens widely before us, when we begin to reflect upon the revolution which this invention is to achieve in commerce, the mechanic arts, and domestic life; and we are compelled to step reluctantly thus upon the very threshhold of the subject. We need not commend the matter which follows these remarks to the attention of our readers, for the subject is one which has justly been an absorbing one to all intelligent minds for some days past; but we must say a word in praise of the modest and dignified manner in which Captain Ericsson has come before the public. He has not bowed, save in respectful courtesy, even to the omnipotent power of the press. He, as far as our knowledge extends, has not sought to win the good will of even its humblest member; but has gone on, silently laboring, until his project reached a perfect development which permitted him to present it, without fear and asking no favor, to any intelligent mind. Such a course must commend the statements which are at last placed before the public to an unusual share of confidence and attention. We detain our readers no longer from the following account of the

TRIAL TRIP OF THE ERICSSON.

On Tuesday morning, about half-past nine o'clock, the *Ericsson*, with a small party of invited guests, left her moorings in the Hudson river, and passed down into the lower bay and returned. The object of the trip was to exhibit the working of the Caloric Engines invented by the gentleman whose name the vessel bears. From a detailed examination of the vessel and the engine, we have prepared the following account:

THE VESSEL.

Of the size, strength, and model of the *Ericsson*, we have before spoken, and that at a time when her timbers were uncovered and open to the inspection of all. Consequently it will now be only necessary to speak of them in general terms. She is 260 feet long on deck; 40 feet beam; 27½ feet hold, and 2,200 tons burthen. She has inside wheels, which are 32 feet in diameter, with ten feet buckets. Her timbers are of the best seasoned white oak, put together and secured in the strongest manner. Her prow is very sharp, bearing no device; her bottom and lines are slightly curved, and on her stern are a figure of the inventor, and two allegorical figures representing the United States and Great Britain in the act of binding a wreath of laurels around his brow. The whole forming a vessel of large dimensions, of unsurpassed strength, graceful in symmetry, perfect in her proportions, and elegant in model. Her builders, Messrs. Perine, Patterson & Stack, may well be proud of their work. Her equipments, aside from her engines, are worthy of particular notice. She has two masts, brig rigged, which, with the ex-

ception of the two exhaust and two smoke pipes, rather an ornament than otherwise, are all the obstructions on the promenade deck.

The spar deck is clear fore and aft, and on it are the dining saloon, pantry, center-house, over the engines; rooms for officers, a library room, smoking room, and firemen and sailors' rooms in the forecastle, with every necessary convenience. There are four stairways communicating with the berth deck, by one of which we may as well descend, after simply noticing that the dining room is large, with neat and tastefully arranged furniture and excellent ventilation. The berth deck is fitted up with sixty-four state-rooms, calculated for the accommodation of one hundred and thirty passengers. The construction and appointments of the state-rooms areneat, with out gaudiness; as is the ladies' boudoir, the style of architecture of which, together with all the saloons, is gothic, and the wood-work is painted white, with chaste gilding. Forward of the state-rooms are rooms for the waiters. There is a continuous passage around this deck, which is one hundred and sixty feet long, and also thoroughly ventilated. On the after part of the saloon, on this deck, are closets appropriated for the ship's linen. By this arrangement, the general appearance of the saloon is improved, as it terminates in a curve. Square or sharp corners are thus avoided, in this as in the rest of the interior of the ship. Next in descending is the cargo deck, which is entirely clear fore and aft, and calculated to carry between thirteen and fourteen hundred tons of freight. The hold, fore and aft of the engines, is also calculated for carrying freight, with the exception of a portion of the space forward of the engines, which is made into a comfortable room, with 12 berths, for passengers' servants. By this arrangement accommodations are provided for a class of persons who have formerly had no particular place allotted to them.

THE ENGINES.

In entering the engine room of the *Ericsson,* the proportions of the various parts of the machine, compared to the steam engine, at once strike the eye. Instead of two close cylinders of moderate dimensions, we behold placed over the kelsons of the ship four large cylinders, open at the top, measuring one hundred and sixty-eight inches in diameter, the pistons of which contain upwards of twenty-two thousand square inches area.

Large as these cylinders might appear, yet they are two feet less in diameter than Captain Ericsson required to give the desired speed to the ship. So great, however, was the opposition on the part of engineers to cylinders of that magnitude, that he was compelled to confine himself to those of the diameter stated. This opposition is now happily annihilated; the four cylinders of the *Ericsson* having been cast in succession, without the slightest accident or defect; and the skilful manufacturers, Messrs. Hogg and Delamater, now offer to furnish cylinders of any required size, cast and turned at their own risk. All practical limits to the extension of the power, therefore, have vanished; and caloric engines may now be constructed of more than equal power to those

of our swiftest ocean steamers. Such is the progress of the arts. What appeared impossible a year ago, is now perfectly easy of attainment; and thus the apparent limits of human efforts are extended step by step.

Over these immense cylinders are inverted four other cylinders, of one hundred and thirty-seven inches diameter, supported on columns or brackets, resting on the upper flanges of the working cylinders, before described. The office of these upper cylinders is that of drawing in atmospheric air, at each stroke of these pistons, through a series of valves applied in the latter, which air so drawn in is forced through other valves, with receivers placed on the top of these supply cylinders. The atmospheric air so drawn in, after being expanded by heat, furnishes the motive power of the machine; and the peculiar mode of heating it is the life and soul of the invention. The four working cylinders are divided into pairs; one pair being placed forward of the paddle shaft, and the other aft. The power of the working pistons is transmitted to the paddle shaft by means of triangular beams, supported on strong pillow blocks, firmly secured between each pair of cylinders. These cylinders are not attached to the kelsons at their lower ends; their upper flanges alone being secured to the frame work of the engine, which is remarkably simple, and rests on six iron wrought columns placed on the bed plates of the kelsons. The attachment of the triangular beams before mentioned to the crank pin of the paddle shaft, is effected by means of two connecting rods; one for each pair of engines, working at a mean angle of about forty-five degrees. By this happy expedient, the centre shaft, which gives so much trouble to our large ocean steamers, has been entirely obviated. The stated position of the connecting rods is such that when the one engine passes what has been termed the dead centre, the other one acts with full power on the crank, imparting to it a very uniform and steady action. The connexion between the triangular beam and the working piston consists of a single link, by which the usual parallel motion in steam engines is superseded. As compared to the ordinary double marine steam engine, the working parts of the engines of the *Ericsson* present a remarkable simplicity, side levers, cross heads, and cross tails being all dispensed with, and the liability to fracture and derangement greatly diminished, to say nothing of the reduced frictions consequent on this simple combination. It is difficult to describe the imposing effect produced on witnessing the operation of the stupendous pistons, working as they do in full view. Our sensation on riding up and down on these huge pistons we shall not soon forget; and altogether we regard the machinery of the *Ericsson* as one of the sublimest engineering conceptions of our times, remarkable as they are for bold strides in mechanics. Let it not be supposed, that owing to the large size of the cylinders, the entire machinery occupies any great space in the ship, as these cylinders take the place of the huge boilers of the ocean steamer.

The heaters and furnaces for heating the air previous to its entering the working cylinders, are placed under the latter. The fire room is located between these furnaces and the coal bunkers, which extend along each side of the engine room under the freight deck. No heat

can therefore be communicated to the coal in these bunkers, whereby great safety is insured, more particularly as the arrangement for admitting the cold atmospheric air to the supply cylinders is such that it circulates through these fire rooms, thus keeping them at a very low temperature.

The regenerators are attached to the side of the heaters, and rest on the bed plates. The cold air from the receivers before mentioned is conveyed through large connecting pipes to the regenerators, the admission being regulated by appropriate valves similar to those of steam engines. The cold air in passing the wire discs of the regenerator becomes gradually heated ; so that, before entering the heaters and moving cylinders, the temperature is nearly but not quite high enough for working; the office of the heaters being that of supplying the small amount of heat lost during the process of transfer at each stroke of the piston. The main supply of heat, however, is derived from the wire discs.

Next to the simplicity and grandeur of the machinery of the *Ericsson*, the observer is struck with the absence of that numerous attendance of engineers and firemen demanded in the steamship. A single fireman on duty is all that is required to feed the fires of this caloric ship; and we may add the extraordinary fact, that so light are his duties and so cool the fire room, that we found him performing them in a pea jacket. As to the engineer, his duties are confined simply to tightening the kegs and lubricating of bearings and pistons, the numerous and important duties of the steam ship engineer, on the strict performance of which depends the safety of all on board, being wholly dispensed with in the caloric ship.

The great objection urged against the caloric engine in regard to the supposed injurious effect of the high temperature upon the packings of the working pistons, we observed to be utterly unfounded. Not only did we find them exposed to a temperature not exceeding that of boiling water, but we found the upper ends of the working cylinders so cold that we could apply our hands to them without discomfort. So in regard to the bottoms of the heaters, which have been supposed liable to be burnt out by the action of the fires, we found them removed from the flues full five feet, and acted upon by a radiating heat only, and not in contact with the burning fuel. Any over-heating whilst the engine is in operation appears to be impossible; the difficulty, if any exist, being to heat them rapidly enough to counteract the cooling effect of the air which enters at each stroke of the pistons.

Among the remarkable features of this engine we noticed that the acting medium is supplied just as fast as the action of the engine requires it ; unlike the steam engine, in which the pressure in the boilers is run down by working faster than is generated. This self-sustaining property of the caloric engine, which is almost independent of the fireman at the furnace, insures a remarkable regularity of action ; not the slightest change in its speed being observable for many hours.

The caloric engine, so far from being a novel invention, the work

of a day, is the result of a whole life devoted almost exclusively to its perfection. Nor is the machinery of the *Ericsson* the first of its kind which has worked satisfactorily ; two other engines on a smaller scale having been in practical operation in this city from time to time during the last two years, without exhibiting the slightest defect, or requiring any repairs. Captain Ericsson, after many previous trials, constructed his first model caloric engine in London in the year 1833. This, although it fully proved the soundness of the grand principle it embodied, had numerous practical defects, the removal of which have occupied the best part of his time from that period until about two years since. In that interval he constructed some nine or ten small engines, independently of experimental apparatus in great variety ; the whole involving an expenditure of not far from one hundred thousand dollars. The leading feature of this remarkable engine, viz., that of employing heat over and over again for producing motive power, when presented by Captain Ericsson to the scientific world in 1833, was at first repudiated by the combined scientific wisdom of England ; but after the persevering efforts of its author to make himself heard, the celebrated Farraday, Dr. Andrew Ure, Dr. Lardner, and others, concurred in the philosophical soundness of the plan, and readily lent their aid in convincing others of its truth. But, with all their science, these men could render the inventor no aid in removing the practical imperfections which yet clogged his beautiful conception. These his own indomitable perseverance could alone combat and finally subdue.

The great feature of the caloric engine, that which distinguishes it from all others, is the use of the heat, once generated, again and again. This discovery, that the amount of mechanical force produced does not depend upon the amount of fuel consumed, is one which entitles the inventor to the lasting gratitude of society ; and the discovery, coupled with it that heat requires no appreciable time to be transferred from one material to another, is one of the most important ever made in physical science. The most characteristic, remarkable, and essential part of the caloric engine depends upon this latter discovery. It is the *Regenerator ;* an apparatus which cools and heats the air which is expelled from and taken into the cylinder, and does this with an expenditure of heat which may be reduced to three degrees, but which it is of no practical utility to reduce below thirty. This *Regenerator* is formed of a series of discs of wire gauze, placed with their flat surfaces together. The size of the discs in the engine of the *Ericsson* is six feet by four, thus presenting a surface of twenty-four square feet of wire gauze, so minute that upwards of one hundred millions of cells are formed by it, by which the air that passes and repasses through it is subdivided almost into its original particles. These *Regenerators* are the lungs of this breathing engine, and they are not unlike lungs in their construction and action. The hot air, as it is driven through them by the descending piston, becomes cool by the time it has reached the outermost disc, and the cold air which rushes in to supply the place of that which was expelled becomes heated by the time it has reached

the innermost disc, and by *the same heat* which the expelled air gave out. The heat is thus imparted by the air to the *Regenerator*, and imparted by the *Regenerator* to the air, in the *fiftieth part of a second.* We need make no more explanations, tell no more wonders, about this grand and simple invention.

PROCEEDINGS ON BOARD.

After all on board had enjoyed the amplest opportunity of examining the engine, and when the vessel's head had been turned homeward, Captain Ericsson explained in a simple and lucid manner the workings of the wonderful machine which they had just seen for the first time. After he had answered in the clearest and most conclusive manner all possible questions, Mr. Charles A. Dana rose, and expressing in a few happy and pertinent sentences the satisfaction and pleasure which he felt on the occasion in common with all present, offered an informal resolution which embodied the spirit of his remarks, and which was assented to with a hearty unanimity; but it was the general feeling, after further conversation, that so important an event should not be allowed to pass without a more formal and deliberate record of the convictions of those who had had the good fortune to be present on an occasion of such absorbing and universal interest. Those present, therefore, organized themselves into a meeting, appointing the Hon. Henry J. Raymond chairman, and Carlos D. Stuart secretary. After the chairman had made a few remarks, directing the attention of those present to the object of their organization, on motion of Mr. Richard Grant White, seconded by Professor James J. Mapes, it was resolved that a committee should be appointed to draft resolutions expressive of the sentiments of the meeting upon the matter before it. Mr. White, Professor Mapes, and Freeman Hunt, esq., being appointed such committee, reported the following resolutions, which, on motion, were passed unanimously, and directed to be published with the signatures of the committee:

Resolved, That this meeting of those present upon the trial trip of the caloric ship *Ericsson* is no less fully and deeply impressed with the grave importance of the subject upon which it feels called to express a judgment, than completely aware of the many advantages to the public which must arise from the now incontestable success of the invention which has to-day been put into practical operation.

Resolved, That, upon thorough examination and actual observation, we are entirely convinced that the invention of Captain Ericsson is no longer of questionable practicability, but from this day takes rank with the foremost of the great and useful inventions which the world owes to science and genius, and that it promises to surpass in efficiency any other adjunct to the advancement of commerce and the industrial progress of the world.

Resolved, That from its economy, safety, and ready applicability to all purposes requiring motive power, the caloric engine cannot fail to minister largely to the happiness of mankind.

Resolved, That the peculiar adaptability to sea vessels of the new motor presented to the world by Captain Ericsson is now fully established, and that it is likely to prove in every respect superior to steam for such purposes.

Resolved, That the remarkable economy of fuel necessary for its working, the absence of all risk from explosion, and the low temperature throughout the ship, even in the engine and fire rooms, as satisfactorily exhibited on this trip, are among the most prominent claims of the caloric engine to the attention of the scientific and commercial world.

Resolved, That in his lucid, simple, and comprehensive statement of his theory, and description of his engine, Captain Ericsson has not only demonstrated the beautiful completeness and perfect working of the system which he has brought, by twenty years' elaboration, to its present commanding position before the world, but has shown a fertility of resource, and a ready command of his vast scientific knowledge, which hardly less entitles him to the admiration of all who heard him.

Resolved, That in the admirable construction of the *Ericsson*, and the beauty of her model, and in the perfectly successful production of so novel and remarkable an engine, Messrs. Perrine, Patterson & Stack, her builders, and Messrs. Hogg & Delamater, her machinists, have shown themselves worthy coadjutors in so noble a project, so important an invention.

Resolved, That E. W. Stoughton, esq., the tried friend and legal adviser of the inventor, with John B. Kitching, esq., and G. B. Lamar, esq., and others, the men who have invested their capital and lent their influence to insure the success of this great enterprise, are entitled to the enduring gratitude of the entire social, commercial, and industrail world.

RICH'D GRANT WHITE,
JAMES J. MAPES,
FREEMAN HUNT, *Committee.*

On motion of Solon Robinson, esq., seconded by Erastus Brooks, esq., it was resolved, that in addition to the names of the officers, the proceedings should be signed by all those present on the trip; and it being noticed that several persons had left before the meeting was organized, it was also resolved that a committee should be appointed to procure the names of those gentlemen who had joined in the previous less formal expression of the opinion embodied in these resolutions.

[It is right that we should add that this committee has almost entirely neglected to discharge its duties.—Eds.]

HENRY J. RAYMOND, *Chairman.*
Carlos D. Stuart, *Secretary.*

Erastus Brooks,	H. L. Webb,
T. Rainey, *Cincin., Ohio*,	John Bigelow,
Alex. Jones,	Chas. A. Dana,
James L. Smith,	Robert S. Webb,
Rev. Sam'l A. Prime,	Hiram Fuller,

Robert Tomes,	William Young,
John E. Durivage, *Cal.*,	Robt. A. West,
Charles F. Briggs,	A. P. Cumings,
Charles Hale, *Boston*,	David Deans,
Henry G. Evans,	Joseph Barber,
John Armstrong,	Thomas Stack,
Solon Robinson,	C. L. Daboll,
J. K. Fisher,	Wm. H. Hallock,
	Augustus Maverick.

During the absence of the committee to draft the resolutions, the meeting was addressed by the Hon. Henry J. Raymond, E. W. Stoughton, esq., and T. Rainey, esq. After the adjournment, the day being far advanced, Captain Lowber spread a cold collation before such of his guests as still remained, and, as might have been expected, toasts were proposed, and heartily drunk, in honor of Captain Ericsson, the enterprising proprietors of the vessel, Captain Lowber, and others present. Mr. Stoughton, Professor Mapes, and Mr. Raymond made some very happy remarks upon the occasion; and Captain Lowber, in acknowledging the toast in his honor, said:

"I offer you, sir, my thanks for your very kind sentiments, and to you, gentlemen, my most heartfelt acknowledgments for this gracious reception of the proposal of my health to them. The hoarse voice of the sailor is more accustomed to contend with the roar and tumult of the wind and waves than to do duty on such an occasion as this; and yet, gentlemen, I should do injustice to you and my own feelings, did I not congratulate you on this most auspicious day, which ensures the success of an enterprise in which our most earnest hopes have been centered. I can but congratulate you upon the complete triumph of that enterprise, and the realization of those hopes. I have stood, gentlemen, upon the deck when the elements in fury seemed about to overwhelm the ship and obliterate man, yet I never looked forward to a safe passage through such a trial with more solicitude than I have watched the progress, and have anticipated the conclusion, of this enterprise. And when the end came, and we stood before the world in triumph, every pulse in my frame quickened, and every artery sent the blood through me with redoubled force. I need not say that this is a proud day for Captain Ericsson. The mind which for twenty years has cherished and nurtured an idea like this, must feel more than pride at its successful application. To him who has conceived and executed we owe all; and it is my sincere trust that he will be fully repaid at this day; and I doubt not that posterity will take care of a fame that will rank with a Fulton and a Morse. I can pay, gentlemen, but a poor tribute to the father of this enterprise—the man who furnished the sinews and reduced the ideas to a fact—the man whose comprehensive mind encompassed its entire scope, and whose sagacious foresight anticipated the result. Need I say, gentlemen, that I allude to Mr. John B. Kitching? Through opposition concealed, and sneers often openly expressed, he went straight on; and the end is his own

best reward, and the conscious dignity of success his best praise. And to those who have constructed and finished the work, they have performed their part faithfully and well. It speaks for itself, and I point to it with pride.

"The gentlemen who constructed the hull can have the satisfaction of knowing that a superior does not ride the waves. Gentlemen, I will conclude with a sentiment:

"*Commerce and Justice.*—Commerce, the pioneer of civilization and the nurse of content; Justice, the handmaid. Nations and individuals alike responsible; connected, humanity must advance."

From the New York Evening Post of Wednesday, January 12.

THE ERICSSON RESPIRATOR.

We have already announced the signal success of the new motive power discovered by Mr. Ericsson, and applied by him to the beautiful vessel bearing his name, and we proceed to-day, in compliance with our promise, to offer such an explanation of its principle as we hope may prove intelligible, if not satisfactory, to our readers.

We will say, then, as preliminary to this explanation, that all the power used in Captain Ericsson's engines is obtained from the expansion of the atmosphere by heat. He uses no water and makes no steam, but employs the atmosphere very much as the steamers employ water; with this difference, that instead of throwing away the heat after it has been used as the steam engine does by condensation, he separates it from the escaping air, and used it over again in heating each new charge of air which is supplied to his cylinders. This economy of the heat of course results in a corresponding economy of fuel, furnace room, and firing equipage, equal, it is supposed, to a difference, in point of expense, of five parts in every six.

We will now give, as near as we can, the process by which this important economy is effected. We desire our figures and facts to be understood as applying to the vessel which we visited yesterday.

The Ericsson, by carpenter's measure, rates as a 2,200 ton vessel. She is supplied with two pairs of engines, and each pair is supplied with two "working cylinders," as they are termed, and two "supply cylinders" inverted over them. The supply cylinders are smaller than the working cylinders, and are filled with cold air from a reservoir over them, at every descent of the piston, which creates a vacuum for its admission. The working cylinders, which are immediately below the supply cylinders, and over the furnaces, are filled by heated or rarified air, and are as much larger than the supply cylinders as is necessary to realize the difference in force between air at its natural temperature and in a rarified state. When the air in the working cylinder is heated, the piston ascends and drives the cold air out of the supply cylinder into a reservoir, where it remains until the rarified air has exhausted its force and is expelled by the descent of the piston in the working cylinder; then, upon the ascent of the piston again, this cold air rushes into the working cylinder, where

it is again rarified, and repeats the motion we have described, and multiplies the force which propels the vessel.

Before proceeding to describe the novelty of the machinery, the process by which the heat is separated from the waste air, and held in deposite for future use, we will give a few of the more important statistics of the dimensions and capacities of the machinery we have already described.

The diameter of each of the working cylinders is 168 inches and its area 22,800 square inches, about three times the area of any of the cylinders of the Collins steamers; and yet they weigh only ten tons, while those of the Collins steamers weigh fifteen tons. The pressure on these cylinders is ten pounds to the square inch, which gives an aggregate pressure of 223,000 pounds for each cylinder. Some of our readers may better appreciate the extent of this power if we add, what is an ascertained fact, that a single pound of pressure upon the piston will raise *eleven* tons.

The "supply cylinder" is 137 inches in diameter, and its area 14,400 square inches. The two pistons, the supply and the working, are connected by eight massive wrought iron rods, which ensure a perfectly simultaneous and sympathetic motion. The power from the piston is communicated to the crank of the paddle shaft by connecting rods placed at an angle of forty-five degrees, and working in such a way as to entirely dispense with the centre shaft in use in steamboats, and obviating all inconvenience from what is technically known among mechanics as the "dead centre." This appliance is also an invention of Mr. Ericsson, and scarcely less important in its results than that which it is our principal purpose to-day to describe; but we do not feel at liberty to explain its principle in detail at present, as Mr. Ericsson is desirous of securing his patent right for it in foreign countries before exposing it to the public. We may say of this invention, however, that it is one which is quite sure of being as universally adopted as his motive power.

We will now attempt to describe the powers by which the heat is economized.

By the side of each working cylinder is a vessel or box filled with a collection of wire discs, like sieves, six feet by four, placed vertically in the box. There are two hundred of these discs in each box. The hot air on leaving the working cylinder, after performing its function by driving the piston up, is expelled through the box of wire, which Mr. Ericsson terms a "regenerator;" but which may be more properly termed a "respirator," as our readers will perceive when they come to appreciate its office.

In passing through the disc, the expelled air gives off all, or nearly all, of its heat—all but about 30°—to the wire, where it is held on deposite, as it were, until the process of expulsion is complete, and the valves open for the admission of the cold atmospheric air, which is waiting to undergo the process of rarification. When the valves open the cold air rushes through the respirator, in which the heat is deposited, takes

it up, and thus enters the working cylinder almost as hot as the air which a moment before deposited the same heat in the reservoir, thus leaving the furnace the moderate duty of supplying a trifling difference of only about 30° of temperature to the air in the working cylinder.

The capacity of these wire meshes to absorb and retain the caloric will not be questioned by practical men when we state that the four "respirators" in the "Ericsson" present a surface of over 15,000 superficial feet, while there are more than 100,000,000 of cells between the meshes. The wire in this boat is about 1-16th of an inch in diameter, but that may be varied of course according to circumstances, as may the number of discs, both depending upon the amount of heat which is sought to be deposited. The surface of wire employed in absorbing the heat in the "Ericsson" is equal to the entire fire surface of four of the very largest size marine steam-boilers.

By a most elaborate series of experiments, the details of which, though exceedingly curious and instructive, we have no time to-day to narrate, Capt. Ericsson ascertained that each particle of air occupies just 1-30th of a second in passing quite through the disc, and in that time undergoes a change of temperature of 400°; that is, the expelled hot air is four hundred degrees cooler when it leaves the respirator than when it enters it, and the cold becomes four hundred degrees warmer when it enters the working cylinder, or heating chamber, than it was when it entered the respirator. It deserves, in this connexion, to be borne in mind that Capt. Ericsson's patent never contemplates a greater heat in the working cylinder than 500°. Yesterday the heat was only about 450°.

In passing through the respirator, it is ascertained that the hot air deposites all but about 30° of its heat; that is, the waste or escape air is only about 30° warmer than when it entered the reservoir cold, and consequently the waste heat is only about 10 per cent. on every 300° employed, and it is this waste only which it is the function of the furnaces to repair. A greater saving might be obtained by employing a greater number of wire discs, and some other obvious cautions, but no practical advantage would be derived from carrying the process of abstraction any further.

From the New York Evening Post of Thursday, January 13.

ERICSSON'S REGENERATOR.

We gave yesterday as correct an outline as we well could, without diagrams, of the structure of the machinery by which the "Ericsson" is propelled, and the constitution and function of the "Regenerator," which is the repository of its accumulated vital forces. We showed how, by the operation of this little machine, only ten per cent. on every 300° of heat was wasted, and that in consequence additional heat, after the engine was put in motion, was only required to repair this inconsiderable waste. We will now describe the heating apparatus.

Under each working cylinder are two furnaces, each about the size

of, if anything smaller than, the interior of an ordinary country house-oven, in which is kept up a moderate fire with anthracite coal.

The distance between the upper surface of the coals and the fire surface of the cylinder is so great—between four and five feet—that the heat from the coals only acts by way of radiation, there being no blaze, and the bottom of the cylinder being entirely removed from any direct contact with the fire.

The ordinary consumption of the four furnaces in the "Ericsson" is six tons in twenty-four hours. They cannot consume over seven tons within that period. They use no blowers, nor any other artificial auxiliaries of combustion; nor, at the highest rate of speed, will the coal burn materially faster than when running moderately; in other words, the cost of fuel will not increase with the speed, as in vessels propelled by steam.

Steamers of the same tonnage as the "Ericsson" never consume less than fifty tons in every twenty-four hours. The Atlantic steamers take in, for a winter voyage, twelve hundred tons. A vessel propelled by a caloric engine, of the same tonnage, at the same rate of speed—and unless Mr. Ericsson's whole theory be fallacious, (which no one can believe who has seen what we saw on Tuesday,) there is no reason for doubting that by proportionately enlarging the cylinders, an equal if not greater speed can be obtained than any steamer has yet reached—such a vessel, we say, thus propelled, will require for a similar voyage not over 140 tons of coal, or about 1,000 tons less than a steamer of the same tonnage.

The Atlantic Steamship Companies estimate the coal for their steamers to cost them, adding the value of the space it occupies to the price of it, $25 per ton. That makes a difference at once in the expenses of the two vessels, resulting exclusively from the cost and transport of fuel, of $25,000 for a single passage.

This vast bulk of coal engrosses all the best freight room in the steamships, while Captain Ericsson can stow away his 140 tons in his coal bunkers beneath the freight deck, beside the engines, leaving all his freight deck entirely free, and of course productive.

In this connexion it is proper to state, that the immense weight of the coal required for the Atlantic steamers compels them to leave port always too deep in the water, and to enter too light for their best running speed; while Mr. Ericsson's ship is no more affected by the weight of the coal necessary for his engine, than an ordinary clipper is affected by the fuel which it carries for consumption in the cook's galley.

There is also an important difference between the weight of the Ericsson's engine and steam engines of equal power. The engine of the Ericsson weighs about 450 tons. The engines of our Atlantic steamers, including the water in the boilers, which of course becomes a part of the steamer's burthen, weigh 1,000 tons.

The power of Ericsson's engines is to be increased, not by raising the temperature in the furnaces, but by enlarging the cylinders, of

which we shall speak presently. An enlargement of the cylinders of course would involve an increase of weight.

But this increase would not be considerable, as the power increases directly as the squares of the diameters of cylinders, so that by doubling their diameters the power is increased in compound proportion. But we need hardly say that this does not involve any proportionate increase of weight either to the cylinder or to the engine.

Now, we have shown that the motive power of one of the first class Atlantic steamers, at this season of the year—

Weighs 1,200 + 1,000 - - - - = 2,200 tons.
That of the Ericsson propeller of the same class, at the outside - - - - - - 800 tons.

Difference - - - - - 1,400 tons,

or, at the ordinary rates of freight in these steamers, an equivalent to more than $20,000. Add to this the cost of the extra coal, which, at $5 per ton, would amount to say $5,000, making an aggregate difference in the expense of the motive power of over $25,000 on each passage, independent entirely of the differences in the original cost of the machinery, and of its wear and tear and repairs, which, a slight inspection will be enough to satisfy any intelligent observer, must be in scarcely a less proportion favorable to the Ericsson patent.

Nor is the economy of this invention, for it is an invention, or a series of inventions, rather than a discovery, confined simply to the articles of fuel and machinery. It does not require anything like the number of firemen and engineers that swarm on steam vessels of a similar class. The "Ericsson" cannot find employment for more than one engineer, one fireman, and one coal trimmer, at a time. The engineer has little to do except to lubricate the bearings of the machinery, and the fireman to attend four double furnaces, which require but little more attention or trouble, and no more skill, than the ordinary house furnaces in our private dwellings.

On the other hand, the engineers, firemen, and coal trimmers of our first-class Atlantic steamers number over fifty persons, many of whom receive high rates of wages.

By this saving of help and equipage in directing the motive power, one of Ericsson's ships may be fully manned by fewer persons, and of course at less expense, than one of our clipper ships of the same tonnage.

It is worthy of special notice that, as the cylinders are fed from the atmosphere, an opening is left all around them from the bottom of the ship to the upper deck, through which there is a constant circulation of fresh air down to the lowest depth of the engine room. From 50 to 70 tons weight of air are emptied into this great reservoir every hour, and we found it as cool, standing immediately beside the fires, as upon the main deck. In the summer this should naturally be the coolest part of the ship.

We have already intimated that the power of these engines depends upon the size of the cylinder. The original plan of the "Ericsson"

contemplated a cylinder of sixteen feet diameter, but no founder would attempt to cast one so large, at the time the Ericsson's machinery was building. The largest cylinder which it was then supposed could be made was one of fourteen feet diameter, and such an one was accordingly furnished for the Ericsson, though only powerful enough for a ship of about two-thirds her tonnage. The experience of Messrs. Hogg & Delamater, who cast these cylinders for the Ericsson, however, has satisfied them of the perfect practicability of casting a cylinder of twenty feet diameter, and we heard one of the firm state publicly, on Tuesday, that he would guarantie as many cylinders of those dimensions as he could have orders for.

That, of course, settles the question as to the practicability of multiplying the power of these engines indefinitely, and, of course, the speed of the vessels in which they may be placed. The "Ericsson," with only about two-thirds the power which is due to her tonnage, has made ten revolutions a minute, which is equivalent to ten miles an hour. No attempt has yet been made to ascertain the highest speed which she is capable of attaining with her present machinery. Nor would such an experiment reveal anything not already demonstrated by the simple fact that a vessel of two thousand tons burden has been propelled through the water by an engine which consumes but six tons of coal in twenty hours, at the rate of ten, or even nine, or eight miles an hour. It is obvious to any man of ordinary understanding that the power, and of course the speed, may be increased almost indefinitely by enlarging the cylinders. The formula of increase, Capt. Ericsson states, to be as the square of the diameter.

There are many other aspects of this wonderful invention which we should have been glad to present to our readers; we should also have been gratified with an opportunity of paying some more suitable tribute to the masterly genius who has worked out this great problem of mechanics, and to the sagacious, liberal-minded, and brave men who stood by him with their open purses during all his long struggle with the practical obstacles to the realization of his theory, which bristled along his path. Some future time we hope to do our part in securing for them the honor which is their due. For the present, want of time and space both, compel us to leave the subject with the simple expression of our conviction, that the employment of heated air as a motive power by Capt. Ericsson, marks an era in the history of mechanism only less momentous and revolutionary than that which commenced with the first application of steam to a similar purpose.

From the N. Y. National Democrat.

THE BREATHING SHIP.

The *Evening Mirror* has the credit of giving the above appropriate name to the first ship put in motion by the new motor, developed by the genius and perseverance of the Americanized Swede, Capt. Erics-

son. This ship, the Ericsson, made its second experimental trip yesterday, having on board representatives of the leading journals of this city, as also editors from Buffalo, Boston, and Cincinnati. Among the party, we noticed Freeman Hunt, of the *Merchants' Magazine;* Messrs. Raymond and Maverick, of the *Times;* Mr. Dana, of the *Tribune;* Bigelow, of the *Post;* White, of the *Courier and Enquirer;* Erastus Brooks, of the *Express;* West, of the *Commercial;* M. S. Beach, of the *Sun;* Young, of the *Albion*; Col. Fuller, of the *Mirror;* Seaver, of the Buffalo *Courier;* Hale, of the Boston *Advertiser*, and editors of the Sunday *Courier*, *Dispatch*, *&c.* Many other persons, eminent in the walks of science, commerce, and the arts, were also on board.

The Ericsson hoisted anchor at a little past nine, a. m., and was going down the bay in fine style, as the Baltic came up. A cannon salute and cheers from the latter vessel as she passed, were answered by a corresponding salute from the "breathing ship." Capt. Ericsson was on board, the observed of all. The vessel was under command of Capt. Lowber, a veteran commander, too well known to the New York press and the American public to require eulogy at our hands. The party on board, after an hour's examination of the noble ship—than which a stronger and finer in model was never built—and its machinery, partook of a handsomely served breakfast. After breakfast and a further inspection of the ship, the party assembled in the after cabin, and listened to a brief, but clear and simple explanation, of the principle of the caloric engine, by Capt. Ericsson, during which he answered every sort of objection that could be raised or suggested, (and there were skeptics on board,) and alluded somewhat to his trials in the course of perfecting an idea which first occupied his mind some twenty-seven years ago.

We have neither space nor time this morning to report his explanations, (illustrated by a hastily constructed model,) but he triumphantly demonstrated the perfection of his idea, in so far as machinists had been able to answer his wants, and utterly upset every objection raised. By the time he had concluded, the vessel had returned to the city and anchored, having made an average of 9 miles per hour, against wind and tide on the downward passage.

Every one on board, so far as we could learn, was thoroughly satisfied with the complete success of the Ericsson, and a unanimous expression of that satisfaction was moved by Mr. Dana, of the *Tribune*, and carried. Upon suggestion, the numerous party was resolved into a formal meeting, to give more definite expression to the sense of those who had so fully witnessed the triumph of the greatest development of modern times.

During the absence of the committee to draft the above resolutions,* eloquent speeches were made by Mr. Stoughton, the legal counsel of the "Breathing Ship" company, Mr. Raymond and others, in which the doubts, ridicule, &c., which Capt. Ericsson has had to combat, were well set forth. After this unanimous acceptance of the commit-

*For the resolutions, see pages 9 and 10 *ante*.

tee's report, the company sat down to a cold collation, at which wit, eloquence, and champagne flowed freely. At three o'clock, the party broke up and went on shore, proud, we are certain, that the genius of man had been able to walk the ocean in a vast ship, propelled with the air on which we all depend for daily life.

Compelled to be brief, we can only add, that the Ericsson measures 260 feet in length of deck, and 40 feet in breadth of beam; her depth of hold is 27 feet, and her burthen 2,200 tons. Like the Arabia, of the Cunard line, she has but two masts; and like our swiftest clippers, she is extremely sharp in the prow. She has no figure-head. Her stern presents the device of two figures, allegorical representations of the United States and Great Britain placing a wreath around the brow of the inventor. She requires but 6 tons of coal in 24 hours, and but one day and one night engineer and fireman. The work of her engineer, in fact, is mainly greasing machinery, and small at that. The Ericsson has cost about $320,000, and considering her saving, in every respect, she may, as a type of her class, be set down as at least one-third cheaper than a steam vessel of the same power and capacity. Accidents from explosion, &c., are out of the question. The Ericsson is furnished simply, but neatly throughout, and has as pure air, owing to her capital ventilation, as that of the open sky. She was built by Perrine, Patterson & Stack, and the chief capitalists engaged in her construction were John B. Kitching, esq., Mr. Lamar, president of the Bank of the Republic, and others whose names we did not learn. These gentlemen, with Mr. Stoughton, Capt. Lowber, and others who have, from their first examination of a working caloric engine, entered freely and nobly into the support of Capt. Ericsson in building this magnificent trial ship, deserve the warmest praise. They have one ample reward in living to see the "humbug air ship" thus proudly triumphant.

It is a little curious that one of those "blue-eyed nations of the North," that were erst the freebooters and pirates of commerce, should finally contribute, through Ericsson, the greatest meed to peaceful, civilized commerce, the world has yet dreamed of. Ericsson has done this. He has built a ship that can breathe itself over the ocean, and his principle only needs slight extension in portions of machinery, heretofore not possible, but now easy of access, to render the caloric ship not only the cheapest, and the only safe from explosions, but also the fastest vessel on the great waters. We feel proud that the United States has had the honor of sending forth the trial "breathing ship," and that Captain Ericsson, a Swede by birth, is an American citizen by adoption. The New World has accepted his grand idea, and will reap the harvest of it, giving him a fortune and a fame the world can neither rob him of nor refuse to endorse. Sweden, with her Linnæus, Brahe, Swedenborg, Ericsson, Tegner, Berzelius, and Lind, may well exult over her record of genius, her illustrious names. In ten years, we predict, steam will be only a venerable remembrance.

From the New York Express of January 12.

THE USE OF A NEW ELEMENT.

The unbelieving world will hardly be prepared for the record of the triumph of the Ericsson ship—a vessel which has twice moved at the rate of nine and ten miles the hour without the use of sails or steam! There have been so many predictions of failure, so many alleged signs of failure, so many doubts, and so much ridicule cast upon the whole enterprise, that perhaps even now it requires something akin to moral courage to tell the world that this great enterprise has at last been successful. But seeing what we have seen, and sailing on board a ship propelled by a new power, it would be rank injustice to the inventor, to the capitalists who have shown confidence in the enterprise, and to the public who have most to hope from the invention, longer to doubt success. In the beginning it ought perhaps to be enough to state that this Ericsson vessel has been once to Sandy Hook and back again, and once, as yesterday, some twelve or thirteen miles out and back; that she has made her nine and ten miles the hour; that she has consumed only at the rate of six tons of coal in the twenty-four hours, and that she has demonstrated the great fact, that a *new motive power can be applied to machinery on sea and land.*

Our reporter has elsewhere given the capacity of the new ship, which, by the way, is as beautiful in her model, and as perfect in her building, as she is novel in her machinery; but there are some things connected with this enterprise which deserve a more public notice.

In the first place, Capt. Ericsson has perfect faith in his invention, and the capitalists who have expended three hundred thousand dollars in bringing the experiment to perfection, have so much faith in its entire success, that they are ready to-day to provide the ways and means for laying the keels of five other vessels.

In the second place, the only drawback to the complete success of the first vessel, viz., the doubt as to a power sufficient to make as good time as first class steamers, will be removed by the discovery of the means to make cylinders of any reasonable capacity. There has hitherto been a limit upon this power, and cylinders of fourteen feet, which is the size of those on board of the Ericsson ship, have before been deemed extraordinary; but Messrs. Hogg and Delamater, machinists in this city, are ready to build cylinders of sixteen, twenty, and twenty-four feet, which is far beyond any thing which has hitherto been made. With cylinders of sixteen feet diameter, Mr. Ericsson is sure of obtaining all that is desirable in the way of power and speed, and such cylinders will be put into the new ships.

For twenty years the idea of propelling vessels mainly by air has been the darling object of Captain Ericsson's life; and now behold the full realization of his wishes. He conceived this idea in England, and it has been realized in the United States. This floating palace upon the water is the full fruition of a long and burning hope. Difficulties of a practical character have from time to time arisen; but one by one

they have been overcome, until promise has become reality. The breathing ship, with lungs, respiratory organs, and every visible sign of vitality, has had her day of trial, and her hour of victory. We think it would be wrong longer to doubt the success of the experiment, or that there is to be a revolution in the power of locomotion.

This new ship, when wholly completed, for she is not nearly finished in her machinery now, will make a voyage southward, and after that probably a voyage to England; first, to convince the magnates of the land at Washington that there is something new under the sun; and secondly, to show John Bull that the motto of Brother Jonathan still is, "that something can be done as well as others."

The Ericsson is one of the most beautiful ships afloat in our waters, both as regards her model, strength, interior arrangements, and decorations. Her modus operandi, or working power, consists, as our readers are well aware, of the expansive qualities of air by means of being heated. The arrangement of her cylinders, four in number, is such that the air within the lower cylinder is heated to such a degree as to impart twice its volume. Each of the four lower cylinders are 14 feet in diameter, under which the heat is applied, by means of which the air expands and raises the piston; directly above these are another set of cylinders, called supply cylinders, each about 10 feet in diameter, the pistons of which are connected with the lower cylinders, and rise and fall alternately with the piston of the former. The cold air is admitted into the lower cylinder through what is called a regenerator, which is simply a number of thicknesses of wire cloth, so packed together, embracing a surface of 6 by 12 feet, as to measure some 24 inches in thickness. This regenerator, or myriad of wire meshes, is also the medium through which the heated air passes off, after having raised the piston of the lower cylinder up, and thus opened the valves which permitted the escape of the heated air. This regenerator absorbs, if we may so speak, the heat from the air as it passes off, and the iron meshes, in like manner, impart a similar degree of heat to the cold air, which is thus made to pass from the supply into the working or lower cylinder. A regenerator is attached to the side of each cylinder, and is, in many respects, the crowning point of excellence of this invention; for, when the air once becomes heated, it not only, by its own expansive power, moves up a ponderous piston, but, having done that, passes off through the regenerator, leaving nearly all its heat in the wire meshes, to be imparted to the cold air which is then allowed to rush in. The amount of heat under the bottom of the lower cylinder necessary to produce 12 pounds pressure of air to the square inch (the average amount of pressure intended to be used by Captain Ericsson) is only about 380 degrees, which is furnished to all four of these cylinders by the consumption of the trifling quantity of six tons of coal in twenty-four hours. The appearance of the machinery is the most beautiful of any we have examined; and the operation of the pistons, as they passed up and down, thus imparting power and mo-

tion to the crank and shaft, and moving a paddle-wheel on either side, of 32 feet in diameter, ten times around in each successive minute, was a wonder that well might tax our credulity to believe in its reality, but such was nevertheless the fact.

There was much pleasant speaking upon the occasion, which came at intervals on the return to the city, and after the vessel was at anchor.

Captain Ericsson delighted the company with his lucid explanations, accompanied by a diagram of the machinery. He had an answer for every inquiry, and seemed to remove every doubt. The great idea of his invention, as explained by him, was the use of heated air over and over again, and by this means the use of six tons of fuel was made to answer the purpose of fifty tons in an ordinary steamship. The space occupied by the coal bunks in the old steamers would nearly cover the space occupied by the cylinders in the new ships, and the space now occupied by the coal bins or bunks would be nearly all saved.

Capt. E. begged that all who had doubts would submit them, and that all who had questions to put would ask them. Many were the inquiries made, but we heard not one which did not appear to be satisfactorily responded to. Indeed, we have never heard any thing more clearly illustrated than the diagrams of the machinery.

At the close, and when the vessel was off Governor's island, Mr. Dana, of the Tribune, proposed a resolution of thanks to the inventor for the pleasure and instruction which had been imparted by his explanations. Mr. D. thought the triumph a complete one; and such, he felt sure, was the judgment of all on board. The resolution was adopted with hearty unanimity.

Professor Mapes spoke of Capt. Ericsson and his invention as having done that which marked an era in the progress of natural science, second only in importance to that, the fame of which is identified with the name of Isaac Newton.

E. W. Stoughton, esq., counsel for Capt. E., and the best friend of the enterprise, also spoke in high terms of the inventor and the liberal merchants who had provided the ways and means to prosecute the enterprise. Conspicuous among their names were J. B. Kitchings, Mr. Lamar, President of the Bank of the Republic, Mr. Hutchings, and others.

After this, a more formal meeting was announced, H. J. Raymond, esq., in the chair, and C. D. Stuart secretary. The chair addressed the company at length upon the importance of the work in hand, and the triumph of genius seen in such an enterprise. Messrs. Solon Roberts, Stoughton, Fisher, Erastus Brooks, Jones, and others, also spoke favorably of the great achievement. In the mean time a committee, consisting of Messrs. White, Mapes, and Freeman Hunt, reported resolutions, &c.

We offer no elaborate report of the remarks made because they were mainly social and private, and as nothing but an examination of the

ship, which now lies off the Battery, can give a just conception of the character of the machinery, we cannot well give in detail to the reader what this vessel really is. Economy in fuel, economy in space, economy in manual labor, and economy in the expense of machinery, are the great things accomplished by this invention; and if there is not enough, there is what perhaps ought to be valued more than all the rest, economy in human life. Firemen are no longer to descend as if to the regions below, there to be roasted alive. The engineer is not necessary to watch a score of stove cocks and valves, upon whose regulation depends the safety of thousands of lives. Neither fire nor smoke is seen or felt, and there is no more danger in being blown up on board of such a vessel than in a sailing ship. *Perfect safety from explosion is certain*, and perfect neatness and quiet are attainable, which is no small consideration to those who have been kept from crossing the ocean by the bad odour and danger of our sea-going steamers. Instead of the pipes belching forth their fire and smoke, and dark as the workshops of Vulcan and Pandemonium can make them, the four pipes of the Ericsson are white as porcelain, and this is symbolical of the neatness which may be observed.

If, then, we are to cross the ocean in perfect safety without the aid of steam or sails, and with more than four-fold economy of fuel and room, and labor, who will not bless the name of Ericsson. Commerce has a deep interest in this question, but the great subject of safety from the perils of the ocean is one perhaps which we can all more fully appreciate.

From the Commercial Advertiser.

All on board, and there were those among them who entertained very serious doubts of the success of the enterprise, and were, we judge, interested in steamships, acknowledged that every objection was proved to be groundless, and that the thing was done. Indeed there was no taking any other ground, seeing that we were *airing* it at nine miles an hour.

From the Evening Post.

It demonstrated that a vessel of that tonnage, and one yet larger, may be propelled at the rate of our first class steamers, with six tons of coal for every twenty-four hours, burned in furnaces which could not be forced to consume more than seven, that being about one-sixth of the amount required for vessels of the same class propelled by steam.

It also demonstrated that the furnaces and engines could be managed with one-fifth the amount of help required for steamers, without any risk from explosion, at very trifling cost for wear and tear of machinery, originally costing only about two-thirds, at the outside, of the cost of the condensing engines.

Capt. Ericsson on this occasion made the first explanation which he has ever made, except to a very limited number of confidential friends,

of the principle upon which his peculiar power is obtained. It was given with a degree of clearness and precision which, almost as much as the ship which was under him, demonstrated its author's genius. Every one was satisfied and delighted, and addresses and resolutions of the most enthusiastic character were adopted.

We trust that some scientific report of the operation of the machinery may at once be laid before the public. Whether it be or not, we shall endeavor to give some notion of what we saw to-morrow. Mean time, we feel that it is no presumption in us, though little conversant with machinery, to say that Captain Ericsson's success is absolute and unconditional.

He has accomplished all he ever proposed to accomplish; he has accomplished all which he has been esteemed a visionary for attempting.

From the N. Y. Mirror of Wednesday evening, Jan. 12, 1853.

THE BREATHING SHIP.

But a few centuries ago the Scandinavian, from his barbarous empire on the north seas, was a freebooter of commerce, a piratical sea-king, plundering surrounding nations and tribes at will. Many a heavy and bloody blow he gave our own fatherland. His rude galleys braved the stormiest coasts, and he shouted his battle song defiant to the world. What a change! The freebooter is become in time one of the bravest and proudest in the path of peaceful commerce, and in the development of world-blessing science and art. To atone for the devastations of the Sigdurds and Erics of other days, one Eric's-son, in our day, has given to the descendants of the nation his forefathers plundered, the noblest and grandest agent yet applied to facilitate the enterprise, abbreviate the labor, and increase the industrial capacity of the world.

We allude to the application of the atmosphere we breathe, as a motive power, to propel the mightiest ships over the ocean, and, in due time, to displace steam from its now passing empire, for all purposes of motive power, on both sea and land. This application, almost free of cost beyond machinery, and that one-third less expensive and bulky than steam machinery of the same power, Captain Ericsson, the inventor of propellers, of tubular boilers for locomotives, and the builder of some hundred steamers, has accomplished. He has completely accomplished and triumphantly demonstrated it by a trial experiment with a ship of 2,200 tons burthen, a magnificent craft in model and finish, which yesterday made its second trip in our waters.

The mighty idea, after twenty-five years of patient elaboration, has come forth from the brain of Ericsson complete, save that the machinery is not yet finished, and its cylinders are two feet less in diameter (none larger could be cast at the time) than was desired to give the experimental ship the power and speed of a steamer of the same size.

We feel it a high honor to have stood on the deck of the Ericsson,

side by side with her inventor, on her first public trial trip. As the Baltic came *steaming* up, dashing wreaths of foam from her prow, and we passed her in the Ericsson, quietly *breathing* her course down the bay, we felt our pulses leap, and our heart thrill, with a proud sense that, brave as steam might be, we had a braver and safer steed, and that the large glory of Fulton was at length eclipsed by the star of Ericsson.

The Baltic boomed forth her cannon, and an eager crowd lining her decks watching our strange ship, without sign of smoke, steam, or sail, made the air ring again and again with their cheers. Our cannon and shouts responded. The steamer passed inland, as though conscious of her coming fate; while the "breathing ship," quietly contracting and expanding her lungs, passed seaward, as though she, too, was conscious of her opening and magnificent destiny.

We are proud to have been one of the party, numbering about one hundred representatives of art, science, invention, and the press, who yesterday witnessed the perfect triumph of Captain Ericsson's "breathing ship." Skepticism has no longer a loop to hang a doubt on. Ericsson has demonstrated his problem; he has breathed a ship, by force of atmospheric pressure, nine miles an hour, against wind and tide. The thing is done, we saw it done, and it will continue to be done, only more rapidly, until something safer, purer, and cheaper than God's air can be found.

We shall give no elaborate report of yesterday's triumph trip of the Ericsson. The party went on board of her at 9 a. m., and she breathed down the bay, and back again, passing the incoming Baltic, as we have said, and at half-past 12 her trip was complete. Enough for her triumph, and for the triumph of her inventor, Captain Ericsson, her commander, Captain Lowber, and the capitalists and counsel, Messrs. Kitching, Lamar, Hutchings, Stoughton, &c., who have nobly forwarded the experiment, that she averaged nine miles an hour, half of the time against wind and tide, and laboring under the disadvantage of unfinished machinery, and imperfect cylinders.

The success could not have been more glorious and perfect. It was sufficient triumph too for her builders, Perrine, Patterson and Stack, and her engine makers, Hogg and Delamater. A nobler or stronger ship does not float, and more simple, ingenious, and perfect machinery could not be desired. During the trip, after an examination of all parts of the ship, the company sat down to a handsomely served breakfast.

Immediately thereafter Capt. Ericsson assembled the party in the after cabin, and, with the aid of a simple diagram, explained the operation of his atmospheric engine, meeting and confuting every possible objection that could be raised. He courted objections. We give a glance at his most interesting explanation.

Mr. E. said the chief principle involved in the operation of this engine was that of using the same heat over and over again. This was effected in a very simple way, through the intervention of what is called a "regenerator" between the valves and cylinder, which is no-

thing more or less than a mass of $\frac{1}{16}$th inch wire compactly interwoven, the whole containing 24 square feet. Upon the heated air passing through this, the caloric is absorbed, and the cold air, in returning, is again heated nearly enough to continue the motion of the engine. Seventy-five tons of air are drawn through the 100,000,000 meshes of the wire each hour. The resistance to its passage is almost imperceptible. In its passage through the meshes the air is instantaneously heated to 400°, as rapid as the electric flash. The wires are not oxidized by the process.

There is a pair of cylinders on either side of the shaft, each composed of two sections; the upper, called the supply cylinder, which is 137 inches in diameter, and the lower, or working cylinder, having a diameter of 168 inches, or 14 feet. The atmospheric air is admitted from above in what is termed the receiver, and circulates between the two sections through side pipes, in which is the "regenerator." Consequently, the pressure above and below, leaving out of view the increased area of the working cylinder, is the same. A pair of these cylinders is placed each side of the shaft. The power can be increased by enlarging the diameter of the cylinder. It was originally intended to have the cylinders of the Ericsson 16 feet in diameter, instead of 14, as at present, but it was thought to be impossible to make them. The increased size would nearly double the power, and give a speed equal to that of any ocean steamer.

Twelve pounds pressure is used to the square inch, and this cannot be exceeded without increasing the temperature, which is objectionable. The furnace fires are five feet from the bottom of the cylinder. One of these furnace bottoms will last five years. Anthracite is the best fuel, as it makes no flame. The cylinder above the fires is $1\frac{1}{2}$ inch in thickness, but is so arched as to have great strength. Even were it to break, the contents of the cylinder would pass off harmlessly. There is consequently no expensive steam boiler to be frequently renewed, and no liability to explosion. If the engineer got asleep, the engine would only stop.

The engine in the E. is of 600 horse power, and not more than 7 tons of coal per day can possibly be consumed. In a steamship of the same power 60 tons per day would be a low calculation. Mr. Ericsson stated further, that this ship was started before she was finished, because it was said to be a dead failure, and the effect was prejudicial to the interests of those concerned with him in the enterprise. But the results had far exceeded his anticipations. But half a pound to the square inch was necessary to start the engines. The weight of the crank alone was sufficient to do this.

As to the comparative expense of running a breathing ship at a high or low rate of speed, Mr. E. stated that it was about as cheap, as far as the engine was concerned, to run ten miles per hour as less.

Mr. E. then proceeded to answer various objections which had been urged relative to the "packing" and "oxidation" of the cylinder, &c., which he did to the satisfaction of all; and individuals, who had pre-

viously been incredulous as to the probable success of the Ericsson, acknowledged that all doubt on their part was dissipated. Mr. Ericsson stated that for twenty-five years he had been maturing this invention. Many difficulties had presented themselves, but time only was required to remove them. Prof. Faraday, Alex. Ure, and others, had long since predicted its success, and he now saw no practical defect in the engine. It would last much longer than the ship—the cylinder bottom was the only part that could wear out.

The current expense of running it he had not estimated, but the difference would be not more than one-fifth compared with the steam engine. The original cost of the engine would also be less. He was quite certain that it would ultimately be applied to locomotion on land, and to various domestic purposes. Its simplicity is one of its most valuable qualities, the number of parts being not more than 1 to 20 compared with those of the steam engine. The wheels are 32 feet in diameter; the buckets 10½ long and 20 inches wide. They are much narrower than usual, but placed closer together. They leave the water very easily. The stock of piston is six feet.

The engine occupies less space than the ordinary one, and is regarded as well adapted to naval vessels, as a clear space (in the E. of 10 feet) is left on either side of it, which would allow room for the management of guns. In the E., the state rooms are continued throughout the entire length of the vessel, and number 64. There are, besides, ample decks for freight, as but little room is required for coal.

To meet the objection, that the new motor would swelter and burn everything on board, it is only necessary to say that, much to the chagrin of Capt. Ericsson, it has been found necessary to *heat the ship by steam*—this being the only steam used. The ventilation is as free and pure as under the open sky. The fire-*man* yesterday found a heavy pea-jacket comfortable. Capt. E. is now making a condensing apparatus for the conversion of salt water to fresh, during long voyages, for washing, drinking, &c., capable of producing from 300 to 400 gallons of pure water per day. He will thus do away, not only with large coal-bunkers, but water tanks, and a voyage may be prolonged to almost any desired extent.

During the trip yesterday but one fireman and one engineer were employed. The duty of the former is little else than to grease the cylinder to prevent chafing, and to see that the bearings don't get hot. Mr. E. said his appropriate name was "greaser." The fireman has to see that the coal don't burn out.

At the close of Capt. Ericsson's explanation, which elicited repeated and hearty applause, and called forth a wish that he might be induced to give a public lecture on the subject, Mr. Dana, of the *Tribune*, rose to express the sentiments and satisfaction of the company, highly complimenting Capt. Ericsson and the gentlemen associated with him. Following Mr. Dana's move, a formal expression of the sense of the company was proposed, and a meeting was organized by appointing H. J. Raymond to the chair and C. D. Stuart secretary.

The chair addressed the company at length upon the importance of the work in hand, and the triumph of genius seen in such an enterprise. Messrs. Solon Robinson, Stoughton, Fisher, Erastus Brooks, Jones, and others, also spoke favorably of the great achievement. In the mean time a committee, consisting of Messrs. White, Mapes, and Freeman Hunt, reported resolutions, which were unanimously adopted.*

In consequence of a desire to communicate with their papers, several editors of evening and other journals were obliged to leave before the final resolution, which accounts for the absence of their names. We regret this, and we are certain they regret it also.

At the close of these proceedings, the party sat down to a cold collation, at which eloquence, wit, and champagne circulated freely. Speeches appropriate to the occasion were made by Erastus Brooks, esq., Mr. Raymond, Prof. Mapes, Mr. Stoughton, the legal adviser of the Ericsson Company, and a gentleman to whom that noble enterprise owes much, Capt. Lowber, and others. Capt. Ericsson, responding to a personal toast, said he "could make no speech, but he could and would thank the company, the press, and all who had aided him, from the bottom of his heart!" It was a right joyous and pride inspiring scene.

The "Breathing Ship" is a fixed fact. The Americanized Swede (an adopted citizen) Capt. Ericsson, has given to the New World the glory of initiating the new motor that is to do away with steam. High honor to Ericsson and the New World. High honor, too, to that fair Sweden, of the "blue-eyed nations," whose Gustavus, Charles the Twelfth, Swedenborg, Linnæus, Brahe, Berzelius, Tegner, Ericsson, and Lind, have blazoned her genius to the world, and cast a radiance on the record of noble and immortal names.

From the N. Y. Tribune, Wednesday, January 12.

THE NEW MOTIVE POWER.

We were present yesterday at the second trial trip of the Caloric ship Ericsson; and are prepared to say without hesitation or reserve, and not merely on our own judgment, but on that of every gentleman in the company, that it proved utterly and beyond the possibility of doubt the existence of a new motive power as sure and efficient as steam, while it is free from all danger of accident, and is vastly cheaper and more manageable. The demonstration is perfect. The age of Steam is closed; the age of Caloric opens. Fulton and Watt belong to the Past; Ericsson is the great mechanical genius of the Present and the Future.

The caloric engine is no hasty product. Twenty-five years ago

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*For the resolutions, see pages 9 and 10 of this pamphlet.

Ericsson conceived the idea. For twenty-five years he has been engaged in elaborating and perfecting it. In 1833 he propounded it to the scientific world at London. Men of the highest authority, such men as Farady and Brunel, pronounced it good, and predicted its triumph. But there were practical difficulties. The principle was clear; not so its application. Those difficulties have had to be overcome gradually, one by one. Since the first model engine of five-horse power was constructed, the inventor has built some twelve or thirteen others, in each making some improvement, removing some obstacle. Two years since his invention was complete. No hindrance remained to be vanquished. He was ready to submit the new motive power to the test of trial on the largest scale. Fortunate beyond other great inventors, at every step he had found means to go forward. And now came the final demonstration. For that means were also found. Enlightened capitalists came forward, and examined, and were convinced. The funds were furnished. It was determined to bring out the machine on a scale unprecedented in the history of inventions. The Ericsson, a splended ship of 2,200 tons, was constructed, the machinery built and put on board. The public trial has taken place at the earliest possible moment, if anything, too soon for perfect justice to the invention. Though the engine was unfinished and unable to perform all the work for which it is designed, yet, as many unfavorable rumors had been put in circulation, such as that it could not move the ship from the dock, that the wheels had to be turned by hand, that it was but a vast humbug, with others of the same sort; in order to silence these assertions, and relieve the owners from the sneers and imputations to which they were subjected, as having thrown away their money on a delusion, it was determined to anticipate the time of bringing out the ship, and to submit the caloric engine to public inspection, even in its present imperfect state, and with the certainty that it could not exhibit its whole power.

This was first done in the trial trip of last week, when only the inventor, owners and crew, of the ship were present. Her performance on that occasion we have recorded. Yesterday a second trial was made. This was for the special satisfaction of the members of the press. Representatives were present from all, or nearly all, the journals of the city, including several of the editors-in-chief of the respective papers. The party was taken from Whitehall at about half past 9 in a small steamer. It was nearly 10 when the Ericsson was put in motion. With the tide and a light breeze against her, she ran down beyond the Narrows, a distance of some ten miles; the tide was also against her in returning; the run each way was accomplished in about an hour and a quarter, making her average speed about eight miles an hour against the tide.

The time on the passage down was spent in discussing an excellent breakfast, and in examining the engine. The first thing in the engine which strikes the observer, is the magnitude of the cylinders. These are fourteen feet in diameter, six feet more than those of the Collins' steamers. There are four in the Ericsson, standing in a

fore-and-aft line; two before and two abaft the shaft, and working in pairs upon it. From the base of the cylinders to the submit is about thirty feet. Each cylinder is double, consisting of what is called a working cylinder and a supply cylinder; the latter being on top and united with the other, though of inferior diameter. The working cylinder has the furnace under it; in it the active force of the machine is developed in the form of air expanded by heat. The supply cylinder is always cold. The working cylinder is 14 feet in diameter; the piston which plays in it has a superficies of 22,300 square inches. The supply cylinder is 11 feet 7 inches in diameter, and the area of its piston is 14,500 square inches. These pistons are joined by powerful iron rods. The stroke is 6 feet. On the under side of the upper piston are valves, through which the supply of fresh air is drawn after the machine is put in motion. Over the supply cylinder is a reservoir in which the upward motion of the piston compresses the air, which passes in there through valves. The connexion between the reservoir and working cylinder is by a large pipe running from the former to the base of the latter. The engine is set in motion by pumping cold air into the reservoir, by hand or otherwise.

From the reservoir, through a valve at the bottom of the large connecting pipe, the compressed air is admitted into the working cylinder over the furnace. Here it is instantly heated, and by its expansion drives up the piston, and at the same time compresses the air in the ply cylinder, and forces it into the reservoir. Then another valve in the connecting pipe opens, and the hot air is let off into the atmosphere. This removes the pressure that has driven the piston up, when its own weight brings it down again, and the escape valve closes. Then the supply valve opens again, and lets the cold air in over the furnace; it is heated, and so the process goes on.

But the great feature of the invention is yet to be described. This is the apparatus by which the main part of the heat which expands the air in the working cylinder is saved, and made to do duty over and over again. This it is that produces the astonishing economy of fuel, which is one of the great characteristics of the invention. In a steam engine the heat is used but once; it passes away, and therefore has to be perpetually renewed. In the caloric engine it is economized. This is an immense advantage. The apparatus is formed of iron wire, $\frac{1}{16}$ of an inch in diameter, woven into a web dense enough for the holes or meshes to occupy half the surface. Fifty thicknesses, or disks, of this wire cloth are used in each pipe connecting the reservoir and working cylinders. Each disk is 6 feet long and 4 wide, and contains half a million of meshes. They are placed close together in the pipe, between the working cylinder and the two valves which let in the new air and let out that which has been used. Thus all the air which comes in passes through the meshes of the wires, as does all that goes out. Here lies the wonder of the invention. The heated air in going out leaves its heat in these wires, and the cold air in coming in takes it up again. In the engines of the Ericsson the air which comes out is but 30° hotter than the atmosphere, though before passing

through the wires it was 384° hotter. Even these 30° might be saved, says Captain Ericsson, by increasing the number of wire disks; but it is practically unnecessary. This apparatus is called the regenerator. Though the principle of it is essentially the same as that of Davy's Safety Lamp, the glory of its application to mechanical purposes is Captain Ericsson's for ever.

As we said, there are four of these double cylinders, four working and four supply. Accordingly there are four furnaces, ingeniously arranged, and set without any extraordinary outlay of brick, such as has been reported. In these a small fire is kept up with anthracite coal, which is preferable to other fuel, because it does not blaze—only its radiating heat is employed. From the grate to the apex of the cylinder-bottom, which is arched of course, there is a distance of five feet. The cylinder-bottom is 1½ inches think. Before the engine is put in motion it may get to a brown heat, but at that distance it cannot get hotter. As soon as the cold air is let in, it cools much below that point. Thus there is no danger either of fusion, cracking, or oxydizing of the cylinder-bottom, all of which have been predicted by the sceptical. A cylinder-bottom will last five years, as long as a steam boiler; or if it gives out, can be easily replaced. The difference in the cost of replacing cylinder-bottoms and steam-boilers would, in a large ship, be from thirty to forty thousand dollars in favor of the former.

The piston in the working cylinder is made six feet deep from top to bottom, concave underneath to fit the cylinder-bottom, and flat at the top. The top as well as the sides are of iron, but the space between is filled with gypsum and charcoal, non-conductors of heat. Thus while the bottom has the temperature of the hot air in the cylinder, the top is perfectly cool. The heat there is barely sufficient to keep the tallow used for lubrication in a fluid state, not to burn it. In fact one can stand upon it as it plays up and down, and many gentlemen amused themselves yesterday by riding there. This enables the engineer at any time to grease just the part of it which he may desire; when the ship is careening for instance, and the friction of the piston is all on one side, that side can be directly lubricated. This is a point of great practical importance, which cannot be attained in a steam engine. Nor is there any danger of burning the packing, for it is at the top of the piston, and never comes within less than six feet of the fire.

The cylinders act in pairs, and in each pair the action is reciprocating; that is to say, as the piston goes up in one, it goes down in the other.

The pressure for which the caloric engine is calculated, is 12 lbs. per square inch; and to obtain this it is necessary to heat the air to 384°. By raising the air to 450°, a pressure of 15 lbs. could be obtained, but 12 is sufficient for practical purposes, and more convenient to manage. Capt. Ericsson is of opinion that that will be retained as the maximum pressure by future builders of engines. Yesterday, owing to the unfinished state of the machine, and especially of the valves, it was impossible to get more than 8 lbs. pressure. With that, nine or ten revolutions were obtained per minute. The full number of revolutions to

be had from the Ericsson's engines is reckoned at 12, and at that rate it is calculated that she will make from ten to twelve miles an hour. This is the utmost that is hoped from her, and we think rather more than will be obtained. Her engines are not powerful enough to make her a competitor in speed with the fast Collins or Cunard steamers. For that she must have larger cylinders. The means of increasing power is to enlarge the diameter of the cylinders. When these engines were built, Capt. Ericsson desired to have cylinders of sixteen feet, but no establishment would undertake to cast them, and fourteen were the largest he could get. Now, Messrs. Hogg & Delamater are ready to make them of any size required, at their own risk.

The smoothness with which the engines worked was remarkable. Captain Ericsson said that ½ lb. pressure was enough to move them. The amount of friction he finds very much less than he anticipated. The coal consumed by the whole four furnaces is at the rate of six tons in twenty-four hours; seven tons is the utmost limit of their consumption. The engineer and one fireman suffice to tend the whole mechanism. There is no unpleasant smell as about steam machinery. There are two smoke pipes and two pipes to carry off the escaped air. These pipes are twelve feet above the deck and thirty inches in diameter. They are painted white, with a gilt rim at the top; but there is not smoke enough to sully them. The amount of air passing through the four cylinders in an hour is from fifty to seventy-five tons. This keeps the ship perfectly ventilated. It was cool and pleasant in the immediate vicinity of the furnaces.

The Ericsson is a beautiful ship as she sets on the water; a lovelier model one would not wish to see. She is 260 feet long on deck; 40 feet beam; depth of hold 27; diameter of wheel 32 feet; length of buckets 10½. With ballast in her, as at present, she draws 17 feet water. Her bottom is moderately sharp, and she is one of the strongest vessels in the port. The hull was built by Messrs. Perrine, Patterson & Stack, of Williamsburgh, and the engines by several builders, under the oversight of Capt. Ericsson himself.

It is not necessary here to add any reflections on the consequences to flow from this great invention. As we have already said, we do not think the Ericsson will prove a fast ship. But the new motive power is as well established with nine miles an hour as with ninety. Larger cylinders will be put into other ships, and speed will be attained which will leave steam as much behind as it is now surpassed in economy, safety, and convenience. In this mighty revolution, the palm of honor belongs to the inventor; but no little credit is due to the gentlemen who have joined him in bringing out the caloric engine on such a scale, prominent among whom we may name Messrs. Edwin W. Stoughton and John B. Kitching. Nor do we desire to conceal a satisfaction which our countrymen will universally feel, that the new motive power has been brought out in the United States.

From the New York Tribune, January 13, 1853.

HOT AIR AS A MOTOR.

There is no good reason for the scepticism with which the announcement of Captain Ericsson's final success is still received in some influential quarters. There is nothing essentially improbable in what he claims, and what all intelligent men, who have examined the subject, believe that he has accomplished. He professes to use a very simple and well-known agency, namely, the expansive power of air, acted upon by heat. That there is such a power no one can deny. It is as familiar as the power of water when similarly acted upon. We know that steam is used to drive machinery; why, then, refuse to admit that hot air may be used for the same purpose? Or at least why reject, without examination, the testimony of so many judicious and cool-minded men, who have looked at the matter, and affirm that the hot air engine is actually built and ready to work, with greater cheapness than steam, and perfect safety? Why should our great steamboat owners and shipping merchants longer persist in the notion that the whole thing must be entirely a delusion?

After all, there is nothing surprising in the continued doubt. The grander the character of a novel principle or newly discovered agency, the more certainly do the mass of men receive it with distrust. We accept the news of failure without hesitation, but the intimations of success we are slow to confide in. Had the journals reported that Captain Ericsson had abandoned the hot air engine in despair, everybody would have believed it; but when told that it is triumphant, that it answers every glowing anticipation of its author, we doubt, and doubt, and refuse to be convinced, till we can refuse no longer. It is too good to be true, is our instinctive reflection. The triumphs of genius and science are held to be impossible till they are achieved. We recollect that Morse's telegraph was long pronounced impossible, and too good to be true.

The mechanism by which Captain Ericsson controls the expansive power of hot air is marked by all the originality and simplicity of genius. As is the case with most great inventions, the wonder is not that it should accomplish the end, but that it was not sooner hit upon. In studying the machine, each part is found so perfectly adapted to its purpose, discharging its function with such economy and certainty, the principles are so clear and the arrangements so felicitous, that it seems rather a spontaneous creation, than the product of long years of laborious thought and gradual improvement. The supply cylinder or great air pump, charging itself with air from the atmosphere, through its valves, as the descending stroke of its piston leaves a vacuum; the reservoir of compressed air kept full by the upward stroke of the same piston; the valve that opens and allows this compressed air to rush into the heater; the regenerator which takes the heat from the air that passes out, to restore it to that which goes in, thus using the same heat

over and over again; the cut-off, which intervenes at just the right moment, closes the valve that admits the compressed air into the heater; the contrivances for confining the heat to its place, and enabling engineers and firemen to work conveniently and in comfort; all these features are so beautiful, so free from complicated contrivances, and so admirable in every respect, that it is impossible for the mind to grasp them in all their relations without satisfaction and delight. Here indeed is the production of masterly genius, to which science is ancillary and nature obedient. It has lately been said that for a general to think rapidly and wisely on the field of battle, to use every circumstance and anticipate every consequence, amid the rustle of bullets and the horrors of carnage, is a great intellectual demonstration, and it is true. But how much greater and nobler the intellectual action which contends with the elemental forces, and in conquering endows man with a new mechanical agent such as this! It is intenser, keener, more comprehensive, more sublime, more intrepid, prolonged through years and conferring a sweeter joy, better laurels, and a more immortal fame. It has another merit. It is a stepping to grander inventions hereafter. It is a new and permanent advance toward the entire dominion of man over nature.

To Captain Ericsson personally it can be a matter of very little consequence whether the incredulity of the world is prolonged a little further or not. He is sure that the true merits of his invention will presently receive a universal recognition. It will be admitted for all it is worth. Its benefits will be enjoyed, and his recompense of honor will not be withheld. A power which by its greater cheapness supplants steam, while it is free from all danger, and can be adapted to perform the simplest domestic and agricultural labor, is sure of a ready and grateful adoption. But we should like to see a little more cordiality toward it on the part of those most largely interested in navigation and commerce.

Hot air as a motor will produce a deep and far-reaching change in human affairs. It will enrich and emancipate the poor, without injuring any. The revolution will be peaceful and happy, and for that reason all the more profound and sure. But when it is fairly accomplished we shall not wonder at it. It will seem only natural. Man will use it as but a part of his birthright, and as the assurance of larger inventions and more beneficent science to come.

From the New York Daily Times.

NAVIGATION.

TRIAL TRIP OF THE CALORIC SHIP ERICSSON.

Complete success of the experiment.

The success of the new motor invented by Captain Ericsson was yesterday exhibited for the first time in presence of a select company

of invited guests. By the courtesy of the inventor, the trial trip was confided mainly to the consideration of the press of this city, and a few gentlemen whose scientific abilities render them amply qualified to pronounce judgment upon a project fraught with such momentous results. The company scarcely exceeded fifty in number, and abundant opportunity was afforded for a minute and careful investigation into the principles involved in the construction of the caloric engine. The trip was most satisfactory, and its results conclusive. The success of the new principle may be deemed certain, and there are no doubts which can now be suggested which may not readily be removed. The performance of the engine, during the entire trip down the bay and returning, was such as to exceed the most sanguine anticipations of the gentleman in whose name the vessel has made her first appearance. Against wind and tide, with the machinery in but imperfect order, the ship made *ten knots an hour* with ease. Her motion is steady, her machinery compact, and her appointments superb. Of the power by which she is propelled we must speak at length, believing that this first success of the principle in its practical application is to mark a new era in navigation, and perhaps produce a speedy revolution of the marine of the world. No mechanical event since the time of Fulton has promised so well for the interest of mankind as the enterprise now so happily inaugurated by Ericsson.

The *Ericsson* lies at anchor off the Battery, in full view of admiring throngs, to whom she is an object of profound interest. The company of yesterday reached her by means of a small steamer provided for the purpose. At a few minutes past 9 o'clock, the anchor of the Ericsson was hoisted, her head was turned to the Narrows, and we sped down the bay at a uniform rate of ten knots against wind and tide. The appearance of the ship at this time, as, with every thing trim and taut, she made her first bow to the public, was remarkably attractive. The company were all in high spirits, and the trip was agreeably accomplished. The ship, having reached a point about nine and a half miles from the city, tacked and wore away toward her anchorage at the Battery; the guests on board, meanwhile, doing ample justice to the generous cheer provided by the officers. The ship again cast anchor at noon, having accomplished the trip out and back—a distance of nearly twenty miles—in about two hours and a half. It should be observed that it was not intended on this occasion to exhibit the sailing qualities of this vessel; so that this rate of speed should be considered rather as the minimum than the maximum of her capability. Capt. Ericsson proposed only to demonstrate at this time the *possibility* of producing effective motion; a promise which he has very fully redeemed. The unavoidable imperfections of the machinery, although trifling, are still such as to prevent any remarkable exhibition of speed. The existence of the new power is fully demonstrable by the fact of motion. Speed is but a secondary consideration.

On the way down the bay we had the fortune to exchange compliments with the Collins steamship Baltic, which reached port at noon,

on her return trip from Liverpool. As the two noble vessels passed each other, they saluted, and the welkin rang responsive to the plash of the waves against the wheels, as the explosion of the guns and the shouts and cheers of the passengers and guests were wafted from one to the other. The scene was striking, and the coincidence noteworthy and remarkable. Steam, in one of its most noble personifications, politely doffed its hat to its new antagonist, and Caloric returned the compliment with interest. The meeting of the craft was an event to be remembered. The *Ericsson* sailing quietly down the Narrows, the *Baltic* whizzing with all the paraphernalia and bustle of the steamship—the one with no perceptible motive power, the other bearing marks of hard usage, and a fight with the elements well won, but still strong and lusty—made up an interesting tableau, which the eye could not choose to rest upon without somewhat of a prophetic vision.

The company on board the Ericsson, availing themselves of the invitation of Capt. Ericsson and Capt. Lowber, spent an hour in examining the machinery and appointments of the ship. They descended to the fire rooms—down small ladders, past which corpulent gentlemen could not hope to penetrate—up impracticable landings, and through the intricate passages of the vessel, and varied the exercise by riding upon the head of the working cylinder of the engines, passing up and down the cylinder with the motion of the piston, and finding the temperature in this place—the hottest of the premises—cool and parlor-like. The sensation of a ride upon the piston of a first-class marine engine, without damage to person or property, was certainly novel and attractive.

Curiosity satisfied, and the minutiæ of the engines having been examined with satisfaction, the guests retired, by invitation, into the saloon, where Capt. Ericsson, in compliance with the generally expressed wish of the company, and in accordance with his own desire to impart all possible information in regard to the peculiarities of his invention, gave a very lucid and succinct explanation of the principles which he has applied, aided by a small model of the engines. The readers of the Daily Times have already been apprised, by former articles in our columns, of the leading characteristics of the new motor; but the importance of the subject seems to demand, in this connexion, a still more complete and detailed description of the mode by which the caloric engine performs its work. We avail ourselves of Capt. Ericsson's plain narrative to complete the sketches given before.

Capt. Ericsson, in explaining the power of his engine, commenced with the furnaces at the base of the lower pairs of cylinders, showing that a very small quantity of fuel is required, and that the attendance of many hands is needless. To produce the power, he remarked, we first pump into the receivers, by hand, a volume of cold air. This air, injected by force pumps, is made to pass down a tube leading from the supply cylinder to the working cylinder below, and enters the lower chamber by forcing up the piston. The pistons in the cylinders having a corresponding action, this upward motion presses more air from the

upper cylinder into the lower, and the action continues until the required elevation of the pistons is obtained. The air passing through the regenerator of the engine, is rendered capable of that degree of expansion which is necessary to the operation of the machinery, and of which we shall come to speak hereafter. The cylinders are peculiar in their construction. They consist of two pairs, and are placed, not side by side, as in the ordinary marine engine, but longitudinally in the vessel. Into each cylinder is fitted a piston corresponding exactly to its own diameter, but so arranged as always to operate simultaneously with the larger piston of the working cylinder. The dimensions of these cylinders, it should be mentioned, are as follows: the working cylinders, 168 inches each in diameter; supply cylinders, 137 inches diameter; length of stroke, six feet. The air passing through the cylinder to produce the desired effect upon the pistons, is compelled to receive its caloric in advance by the action of the regenerator. A series of wire-nettings, placed side by side, to the thickness of twelve inches, presents a metallic surface of 15,000 square feet, in which are contained upwards of 100,000,000 of meshes—minute cells, through which the air is forced, and in which it imbibes or parts with caloric to the amount of 450°. The maximum temperature which is requisite for doubling the volume of atmospheric air is 480°, of which 30° are afforded by the furnace, and the residue by the regenerator. It was ascertained by careful experiment that air will acquire or evolve heat very rapidly when placed in contact with a metallic surface. This action is instantaneous. The minute subdivision of the cells attained by the construction of the regenerator of the caloric engine, produces the full effect of this simple law of nature. As the volume of air taken in by the action of the cylinders passes through this contrivance, it takes up continual additions of heat, increasing in temperature as it approaches the furnace, and when it is admitted to act upon the cylinder, it is with such expansive force that the piston is driven up with great power, carrying with it the corresponding piston of the upper cylinder; while the air, having performed its duty, now returns into the regenerator, is deprived of its heat, save about 30°, and is ejected into the air nearly as cold as when it entered; the loss of heat being but 30° out of 480° previously absorbed. It will thus be observed that the loss of power is very small, compared with that of the steam engine, where the escape and waste of material is very great. The cylinders being connected by a walking beam, the centre shaft of the steam engine is done away with, and the action of the engine is reciprocating. As one pair of pistons ascends, the other in consequence descends, and the reverse; so that a continual reciprocating motion is given to the machinery operated by the cylinders, producing a steady revolution of the paddle shaft.

The explanations of Capt. Ericsson were frequently interrupted by queries respecting important principles adopted in the construction of the engine, a few of which we note.

Q. What are the relative degrees of heat in the upper and lower surfaces of the regenerator?

A. The first layer of wire is very hot, but the temperature decreases as the distance from the furnace is increased.

Q. What is the superficial area of the regenerator?

A. Six feet by four, or twenty-four square feet.

Q. What is the amount of resistance to the air as it passes through the regenerator?

A. Only one-half of the space occupied by the regenerator is pierced for the meshes. The resistance will be about one-half of an ounce to the square inch.

Q. What is the diameter of the wire?

A. About one-sixteenth of an inch.

Q. What is the number of meshes to the square inch?

A. About five or six.

Q. What quantity of air is taken in by the cylinders when in full operation?

A. When the ship is under full headway, the engine making 13 strokes per minute, the cylinders take in 75 tons of air per hour.

Capt. Ericsson—resuming. As to the objections which have been raised to the application of this principle of heated air, I must make some explanation. It has been objected, first, that our packing will burn out. Now, the piston is a hollow chamber, six feet deep, filled with plaster of Paris and charcoal, a non-conducting medium, which prevents it from becoming so heated as to endanger any thing. The lower side of this piston is exposed to all the heat of the furnaces, while its upper surface is almost cold. The reason why it is so cool, is because of the non-conducting quality of the packing. So far, therefore, from the packing being liable to burn out, it is not even hot; you may put the hand upon any part of the cylinder.

Q. What is the method of oiling the machinery?

A. The lubrication of the pistons is easily effected by the peculiar conformation of the cylinders. The cylinder is not hot enough to prevent free access to any part of the piston, and the machine might grease itself; but it so happens that the engineer has nothing to do. [Laughter.] The engineer, in short, is nothing but the "greaser." [Renewed laughter.] The pistons do not chafe, and hence there is little or no friction. If the ship careens, and it is necessary to lubricate the pistons more on one side, the engineer meets the want and applies the remedy where it is needed. The temperature of the fire room also, as gentlemen will have noticed, continued the Captain, is very low. The men are now firing in their pea-jackets.

Q. What is the amount of cold air drawn into the cylinders in a given time?

A. An average of 60 to 70 tons per hour.

Q. What is the amount of power obtained in this vessel, and at what rate do you estimate the power of the caloric engine?

A. Twelve pounds to the square inch is the highest degree of pressure which we deem it advisable to employ, and even less than this is sufficient for ordinary purposes. As the pistons are 22,000 square inches in area, a pressure of 10 pounds for the square inch gives 220,000 pounds of mechanical force. If it be deemed advisable to obtain an augmentation of force, it is only necessary to enlarge the cylinders, and thus augment the power. We now know that we can make cylinders large enough to supply any want. My original calculation (added Capt. Ericsson,) was to use cylinders of 16 feet diameter, but it was deemed impracticable to exceed at first the present dimensions of 14 feet. Were I to build the engine anew, I should adhere to my original plan, and make the larger cylinders each 16 feet. The feasibility of the enlargement of the cylinders is now so well established, that a house in this city, Messrs. Hogg & Delamater, the builders of these engines, will now engage to furnish cylinders of *twenty feet diameter*, and to bore them at their own risk. [Great applause.] Were we able to introduce cylinders of 20 feet, we should be able to surpass anything that floats upon the ocean, and the effect of the improvement would be extraordinary. The enlargement of the cylinders would not cause them to occupy a much greater space in the ship, so that there would be no appreciable loss in room; and the larger the cylinder, it will give more power. In other words, the power of the engine is in proportion to the square of the diameter of the cylinders. [Applause.] There is another objection which has been urged. It has been said that the application of dry heat will produce the effect of burning out the furnaces, but it is obvious to the most careless spectator that this can never happen, because the fire is removed to a distance of five feet from the bottom of the cylinders, and the fuel used is anthracite. We don't want flames, because we operate simply by radiated heat. We *might* make the bottom of the cylinders red hot, but the most common trouble is, that they cannot be made hot enough. There is a radical difference between the caloric engine and the steam engine in this respect. The action of heat upon our cylinders produces no ill effects, and it is only necessary to replace the furnace when it shall become unfit for use; though that contingency occurs but rarely; whereas, in the steam engine, in four years the boiler is destroyed, and must be entirely replaced. Nothing of this kind being required in this engine, there being no boiler to be corroded, the saving is very great, perhaps $30,000 to $40,000 every four years in a large ship. I have built several engines since I started the plan of this, and have known some of them to last for four years without a renewal of the furnaces.

Q. What is the thickness of the bottom of the cylinder?

A. One and a half inch.

Q. Do you find no trouble from oxydation?

A. None whatever. There is a slight red oxyde formed; but it is so slight as to be of no trouble. The oxygen is all consumed in the fire, and no residuum is left to occasion oxydation of the cylinders.

Q. Could wood be used to fire the furnaces, as in vessels navigating the Mississippi river?

A. Wood would hardly answer; it would consume too quickly, and the boats would be obliged to fall back upon coal.

Q. What amount of coal do you consume per day?

A. On an average, from five to six tons; it would be almost impossible to consume more than six tons. The steamships consume forty to fifty tons daily. There is accordingly a great saving here.

Q. What is your opinion of coke as a fuel?

A. It would answer admirably.

Q. Does the extent of the power depend upon the degree of heat or the size of the cylinder, or are both indifferently increased?

A. We increase the size of the cylinder to obtain an augmentation of heat.

Q. How high is the power of this vessel?

A. About six hundred horse-power.

Q. Can the power be applied to small machines?

A. Undoubtedly. I made a machine a foot in diameter which ran with half horse-power. The principle is of easy application.

Q. In what ratio does the increase of the diameter of the cylinder increase the power?

A. Just the same as the increased area of the piston.

Q. Are you perfectly satisfied with this trip as a first trial?

A. *It has exceeded my highest anticipations.* With the low-pressure which is now employed, the engine has already effected more than I had any reason to anticipate. [Cheers.]

Q. In regard to the amount of friction, what is it?

A. The amount of friction is less than that of any other engine.

Q. What amount of pressure is required to commence operations?

A. So little that a half pound pressure to the square inch is sufficient to give motion to the whole.

Q. What is the number of valves?

A. Thirty-six in each piston.

Q. Is it any cheaper to run at a moderate rate of speed?

A. It is somewhat so; the amount of resistance of the water being as the square of the velocity.

Q. Is there any difficulty in keeping the piston valves in order?

A. None. If any thing gets out of order, there is a man-hole in the top of the supply-cylinder, so that a man goes in with a light, looks about, remedies the evil, comes out, and shuts the door behind him, and there is an end of it. [Laughter.] In the steam engine, on the contrary, whenever the valves are deranged, we must take off the head, weighing some five tons, then wait three hours for the engine to cool. Not so here.

Q. How long a time do you take to pump in the air for starting?

A. A very few minutes.

Q. What would happen if the engines were neglected?

A. The worst would be that the machinery would stop.

Q. How long since did this idea occur to you?

A. It has been cherished for twenty years. In 1833, I brought out in London my first model caloric engine, which ran with five horse power; and since that time I have built twelve or thirteen such machines.

Q. Do you remember the name of the British reviewer who commented favorably upon your invention about that time?

A. Nearly all the English mechanical journals of the day discussed the subject. Professor Faraday, however, and Dr. Andrew Ure, regarded my enterprises favorably. When the subject was first agitated, it was denounced as involving, among other things, the "chimera of perpetual motion," but experiments caused some of these doubts to be removed. Mr. Faraday was much interested, and lectured upon the new principle before crowded audiences at the Royal Institution. For nearly twenty years, therefore, I have pondered on this invention. During all this time, *I have never been at a loss for means*, (applause,) and on reaching New York and making representations to your capitalists, I met with a number of merchants, supported by other gentlemen of capital, who afforded me ample opportunity of testing the caloric principle on this large scale. (Cheers.) The thing is accomplished; there is no remaining difficulty in the way which cannot be met; there is no doubt that cannot be answered. The principle has been tested long enough to prove that it is reliable, feasible and successful. (Cheers.)

Q. Will you state what is the relative cost of the caloric ship and steamships?

A. The cost will be about two-thirds that of the steamships; that is, there will be a saving of one-third in expense.

Q. What is the ratio of expense as regards the employment of engineers and firemen?

A. About in the proportion of 1 to 5.

This ended the explanations and their accompanying colloquies. We have sketched briefly and rapidly from recollection of the salient points of a very interesting and instructive discussion.

An expression of the sentiments of the company seeming to be appropriate to the occasion:

Mr. Charles A. Dana, of the Tribune, made a few remarks, alluding very happily to the clearness and pointedness of the illustrations given by Captain Ericsson of his new invention. The time had come when the wants of commerce called for more safe and trustworthy agents. The genius of Captain Ericsson has inaugurated a revolution in the world of business. All classes are looking anxiously forward to this event, and the world will hail the success of this important enterprise as the commencement of a new and prosperous era in history. The Press is especially indebted to Captain Ericsson for the opportunity he has afforded its members, not to criticise, but to examine his wonderful invention; and the representatives of that body will cherish a gratifying recollection of the triumph they have witnessed this day, and the prospect which opens brightly upon the future.

Similar remarks followed from Messrs. Solon Robinson, James J Mapes, H. J. Raymond, E. W. Stoughton, and others, and the guests dispersed—only, as it afterward appeared, to reassemble in due form for the passage of the customary resolutions which end off and smooth the last scenes of steamer trial trips.

There can be no better place to introduce a subject which attracted general attention in this interim "between meetings." The *freight deck* of the *Ericsson* is not the least among her beauties. The method of construction of the engine, and the small amount of fuel required to feed the furnaces, produces a remarkable economy in the stowage capacity of the ship. The amount of freight that may be received will be 1,400 tons. The freight deck, strongly secured from accidents, is roomy and cleanly. It is perfectly clear from stem to stern, in consequence of the small space occupied by the machinery of the ship, and affords, beside the freighting space proper, storerooms and recesses, always useful for the stowage of precious articles. The coal hold is below the freight deck, and is abundantly spacious to contain the entire mass of fuel required for the outward and return voyages of the ship. It is ascertained that the vessel will be able to carry her coals for the longest trips out and back, even should the voyage be extended beyond the customary route of our packet steamers. The steamships can carry a supply sufficient only for a single trip.

Of the internal arrangements for the comfort of passengers, it is only necessary to say that the saloons, state-rooms, and appurtenances are of the best stamp. No ship sailing out of this port will surpass the *Ericsson* in beauty and completeness of interior appointments. Curled hair mattresses, the daintiest of linen, with marble stands, gilt ornaments, and carpets of the newest pattern, compose the furniture of the state rooms. Gothic entrances open into the cabins; the chairs and sofas are covered with crimson plush; the carved-work is of the most chaste and elegant pattern; and a carpet design, representing the flag of America embowered in the midst of forest foliage, lends a sort of enchantment to the understanding of the passer-by. The saloon, forward and aft, are heated by the customary appliances. A neat little *bijou* is the ladies' boudoir in the after cabin—a semi-circular apartment, elegantly finished and very retired.

The complete dimensions of the *Ericsson* are as follows:

Length between perpendiculars	250 feet.
Breadth of beam	40 feet.
Depth of hold	26 ft. 6 in.
Tonnage, register measure	1,903 tons.
Working cylinders, (diameter of each,)	168 inches.
Working cylinders, length of stroke	6 feet.
Supply cylinders, (diameter of each,)	137 inches.
Supply cylinders, length of stroke	6 feet.
Chimneys, two in number, (diameter)	30 inches.
Ventilating tubes, two in number, corresponding to the chimneys, (diameter,)	30 inches.
Paddle wheels, (diameter)	32 feet.
Paddle-wheel buckets	10 ft. 6 in.

The owners of the vessel are a company of gentlemen of wealth and

influence, among whom is John B. Kitching, esq., a prominent merchant of this city. Her builders were Messrs. Perrine, Patterson & Stack, of Williamsburg; the engines were constructed by Messrs. Hogg & Delamater, of New York.

The destination of the *Ericsson* is yet undecided. In fact, some time must necessarily elapse before she can be made ready for a sea-voyage. We append a list of her officers, so far as they are appointed:

Captain—A. B. Lowber.
First Mate—Henry C. Bacon.
Second Mate—Thomas Dorsan.
Third Mate—James H. Kitching.
Surgeon—Dr. A. A. Lines.

MEETING OF THE GUESTS.

At the suggestion of several gentlemen present, for the purpose of making some more formal expression of opinion concerning the trip, a meeting was organized, of which, on motion of Mr. Stoughton, Mr. H. J. Raymond was appointed chairman, and C. D. Stuart, secretary. Mr. R. G. White moved that a committee of three be appointed to prepare and report resolutions expressing the sense of the meeting. The motion was adopted, and the chair appointed R. G. White, esq., Prof. J. J. Mapes, and Mr. Freeman Hunt on the committee. After they had withdrawn for the performance of the duty assigned them, E. W. Stoughton, esq., made some remarks upon the practical difficulties encountered in the prosecution of this work—the objections raised, and the ridicule indulged by various parties interested in business projects which might be injured by the success of this invention, and the noble manner in which a few men had come forward with money and personal aid to carry it on. Mr. Raymond made some remarks upon this case, as an illustration of the extreme difficulty with which anything new, no matter how true or important it may be, forces itself upon public attention, and is finally admitted into the recognised order of things; of the vast importance of Captain Ericsson's invention; of the true nobility of character evinced by those who had faced obloquy, and risked their wealth in carrying forward this great experiment; and of the just appreciation by Captain Ericsson of the true function of the Press, in not asking its judgment, or its aid, *in advance* of success, but in simply soliciting its attention to the question, after everything had been done, and the machine constructed, whether its performances were successful or not. Erastus Brooks, esq., followed in some very felicitous remarks upon the importance of the invention to the world and the general progress of science. Several other gentlemen also spoke, until the committee returned, and Mr. White, on its behalf, reported the following resolutions:*

The company, upon the invitation of Captain Lowber, then sat down to a bountiful lunch which he had provided. After this had

*For resolutions, see *Courier & Enquirer's* article.

been despatched, Mr. Raymond proposed Captain Lowber's health, speaking of him as a noble specimen of a noble class, the ship captains of our port, and as entitled to special credit for the manliness with which he had devoted himself to the realization of the grand idea of this new motive power. Captain Lowber replied in a very handsome speech, thanking the company for the honor done him, and declaring his full conviction in the entire success and certain triumph of the caloric engine.

The health of the inventor of the Magnetic Telegraph was next drank, which Mr. Sidney E. Morse acknowledged. Capt. Ericsson's health came next, and was received with long and loud applause. In reply; he declared that he could not make a speech, that he should not try, and that he had only to express his cordial thanks for the compliments paid him. Prof. Mapes was toasted, and made a speech full of humor, both in matter and in manner. E. W. Stoughton, esq., responded to a complimentary toast, and in closing gave the health of those gentlemen who had so promptly and generously furnished the money for the construction of the *Ericsson*. Mr. Hutchinson, being designated as one of the persons alluded to, said that when he was applied to by a friend to aid this enterprise he thought but little of it, until he was told that if the experiment should succeed *there would be an end to steamboat explosions*. Upon that hint, he said he subscribed $10,000, feeling that any experiment which promised to put an end to the dreadful scenes of death by steam we are almost daily called to witness, deserved to be aided by every man who had friends to love, or sympathies for the sufferings of his fellow men. He said he had thought but little more about it; he had paid his money cheerfully, been laughed at a good deal by his friends, which he had borne with a good deal of philosophy, and began to think now that *his* turn for laughing was not very far off. Mr. Hutchinson's remarks were received with warm applause. After he had concluded, Mr. Raymond proposed his health, as that of *the Merchant who cared more for human life than for ten per cent.;* which was responded to with hearty acclamations.

From the New York Daily Times of Wednesday, Jan. 12.

THE CALORIC SHIP ERICSSON.

The introduction of a *new motive power* into the economy of life is an event of far more importance to the world than any political incident however startling, or however vast the interests it may seem to involve. Changes of dynasties, the transformation of civil governments, the rearing or the razing of empires, are transitory and trifling in the interests they affect, compared to the discovery of a new power, and its successful introduction as an ally and an agent in that great war which it is the mission of man evermore to wage with nature. We look, therefore, upon those columns of this morning's *Times* which record

the result of yesterday's experimental trip with the caloric ship Ericsson, as announcing a more important fact than has been brought to the knowledge of the world since the discovery of steam; the fact, namely, that the trial was entirely satisfactory, the experiment perfectly successful, and that heated air stands by the side of evaporated water, among the active forces by which man is hereafter to subdue nature to his uses and his will.

If this were the expression of an *opinion* upon a scientific subject, it might justly be deemed arrogant and worthless. Comparatively few men are competent to pronounce such judgments upon such topics; and those are the very men who would do it with cautious hesitation. But our task is simply to record *a fact*—as patent and unmistakeable as the rising of the sun; and that fact involves the whole case. When Fulton saw the wheel of his small ship *turned round by steam*, he knew, and all who saw it with him knew, that steam as a ship-propelling power was established. How costly it would prove, how fast it would drive a vessel, how dangerous it might be—these were minor considerations to be settled afterwards. The fact of its power, and of its applicability to the work of driving ships, was the great fact just then of paramount importance to the world. Heated air has passed through that same ordeal, and has achieved at least an equal triumph. Forty or fifty gentlemen—intelligent, disinterested, unprejudiced—were invited on board the Ericsson, not to give scientific opinions, nor to pronounce judgment upon scientific theories; but to look at an engine driven by heated air, and to observe, as a matter of fact, *whether it went or not*. And it *did* most unquestionably go! That immense ship was driven against wind and tide, by machinery far from complete or perfect in its construction, at a steady rate of *ten miles an hour;* and without referring at all to anything farther, in that fact alone the principle finds its complete and triumphant vindication. The use of caloric as a propelling power is no longer a theory—no longer an experiment; it is a *fixed fact*.

And yet that fact, transcendant as it is, includes but a small part of the advantages and merits of the invention. Unless we are very greatly deceived, there can be no doubt whatever, that heated air thus applied, will be found far *cheaper*, and infinitely *safer*, than steam. On board the Ericsson the air is heated to a temperature of 450 degrees, giving a working power of twelve pounds to the square inch. This degree of heat is maintained by the use of six tons of coal a day—without unduly heating the metal of the cylinders or furnaces—leaving the fireman's room, amply ventilated as it is, cool and comfortable; and with cylinders fourteen feet in diameter, giving a power equal to that of the largest and swiftest steamer afloat. Captain Ericsson, therefore, proposes never to seek a higher degree of heat; but the *power* of the engine can be indefinitely augmented by *increasing the dimensions of the cylinder*—the power being in proportion to the square of the cylinder's diameter. It has been pronounced impossible to construct a cylinder 14 feet across; but as it has been *done*, the objection loses

weight; and Messrs. Hogg & Delamater, the builders of these engines, declare their readiness to make, and to warrant, as many as may be ordered *twenty feet* in diameter. Any desirable increase of power, therefore, may readily be attained by the easy process of increasing the size of the cylinder; and that is done at comparatively slight cost without greatly increasing the space occupied, and at a very trifling addition to the working expenses.

There are very many persons whose *interests* will be injuriously affected by the introduction of this new agent. It is natural that they should be reluctant to believe in its feasibility; that they should be fertile in objections, distrustful of evidence, and obstinate in unbelief. But they cannot alter *the fact*. And they will most effectually protect at once their interests and their reputation, by adjusting themselves to the new power and the changes it must effect, rather than by quarreling with it, and disputing its existence. Caloric ships will very soon take larger cargoes, at less freight, with lower rates of insurance, than steamers; and that process once commenced, the inevitable result will be close at hand. For one thing alone, if there were no other to recommend it, every man living should hail the advent of this new power with sincere rejoicing. *It is free from danger*. Explosions are impossible. No human life can be lost through its agency. It is as harmless as the air we breathe. In this fact, aside from its economical advantages, the world may find abundant reason to welcome its introduction as one of the greatest boons ever conferred on the human race.

From the New York Sun of January 12.

TRIAL TRIP OF THE ERICSSON.

At nine o'clock yesterday morning some fifty or sixty gentlemen, about half of whom are connected with the press of this city, met on board a small steamer at the Government barge office, pier No. 1, East river, and were thence taken to the caloric ship Ericsson, for the purpose of witnessing her performances during a short trial trip down the bay. The ship has already been described at some considerable length in our columns. She is all that could be wished for in model and decorations. Her graceful appearance, while at anchor or in motion, during the last few days, has been the theme of general remark, and the internal decorations are equally deserving of notice. She is chastely, conveniently, and prettily, but yet not expensively, fitted up; is calculated for *comfort and use*, and not for mere glitter and show. The engines were, of course, the principal attraction to the excursionists, as they will also be to our readers, and we shall be excused for at once entering into a partial description of them.

The advantages claimed for engines constructed on the plan and size of the Ericsson over the steam engines in use, are—

1st. A saving of from six-sevenths to seven-eighths of the fuel consumed.

2d. A saving of from four-fifths to five-sixths of the labor required in managing.

3d. A saving of at least ninety per cent. in wear and tear.

4th. Increased facilities for examining into every part of the machinery, and correcting derangements when they occur.

5th. In simplicity of arrangement and ease of management.

6th. Perfect immunity from explosion, and additional security from fire.

On arriving upon the Ericsson's deck, and passing through the engine room while the ship was moving down the bay, our attention was particularly drawn to the absence of all bustle or confusion among the men employed on board. In fact, we might almost say there were no men employed, for, save the half dozen sailors on the deck, it was a difficult matter to find one. *Those immense engines were entirely controlled and cared for by two men—one fireman and one engineer—and they did not seem particularly busy either.*

The shifting bar which starts, stops, and reverses the engines, might easily be managed by a mere child, and that is the only part which needs the engineer's attention. He has no try-cocks to examine, no water-level to keep watch of—nothing to do, except to put on the tallow or other necessary lubricating compound now and then. The fireman, too, is a man of leisure. He has eight furnaces to be looked after, and they are by no means such ones as are ordinarily in use for steam engines. Each of them contains a slow or dead fire, which requires renewing with coal only once in two or three hours. His cares and labor are those of a man who has to keep eight ordinary coal stove fires going, nothing more.

The engine-room is a model for coolness and ventilation. The fireman, instead of being stripped to the skin, may, and yesterday did, work there with his pea-jacket on. The air which supplies the engine comes down through open hatches into the engine-room, and, having been drawn into the supply cylinder, is afterwards ejected through two of the four pipes above the deck, the other two pipes being the smoke pipes from the furnaces.

The machine itself was, very happily, compared to *an immense breathing monster*, by some of the gentlemen on board; and the idea is well borne out by the fact. The regenerator may be said to perform the office of the lungs, and then we indeed have the heaving chest and the sinewy limbs before us. Calling it a "Caloric Engine," however, seems to us a misnomer. It is, in effect, an "atmospheric" or "air engine," inasmuch as it is operated by means of air, as the steam-engine is by steam.

And here let us turn aside to make a remark on another subject. Some years ago the idea was broached, and to some extent experiments were tried, of ejecting air through perforations in the hull of a vessel, with a view to diminish the friction of the water. How far this was

successful, or "whether the game is worth the powder or not," we cannot say, but if there be anything in it, Captain Ericsson might turn his exhaust air to most excellent purpose in that direction.

The result of the trial trip as to speed is not a point of very great importance at the present time, inasmuch as the engines cannot be considered as in anything like perfect operation. It will be quite enough for intelligent mechanics to know that any motion at all is produced, particularly as the cylinders are of two feet less diameter than Captain Ericsson intended and wished they should be; it being found impossible to induce foundrymen to undertake larger ones. On starting the engines, the number of revolutions of the wheel per minute was about nine and a half, and during the entire trip they varied from eight and three-quarters, to nine and three-quarters, and the speed through the water was at the rate of between eight and nine miles per hour.

The ship left her anchorage opposite Pier No. 1, North river, and proceeded down to the Narrows, turning about at a short distance beyond Fort Diamond, and returning to her anchorage again; being absent in all about two hours and a half. Starting on the last of the flood tide and returning on the first of the ebb, she had tide against her both ways, lessening her speed, (except through the water,) an average of about one and a half or two miles per hour. The whole distance performed through the water was not far from twenty-two miles.

We can no longer call the Ericsson an experiment. *It is an established fact*, and one which must stand out as such in all future time. The invention, thus far, is more triumphant than that of Fulton with his steamboat; even more triumphant, after considering the known disadvantages under which Fulton labored. The use of heated air is not, to be sure, a new thing to inventors. Many have tried it, and one or two have been partly successful. But this, instead of detracting from, rather adds to, the merit of Captain Ericsson. He alone has persevered *to the end*, and after twenty years of trial and experiment has been rewarded by the fullest success. No one conversant with the attempts and failures of most enterprises can examine the Ericsson in all its parts, without pronouncing her the miracle of the age; for such they must consider the construction of so large and fine a ship, complete in all its parts, moved by a power hitherto unknown in all practical respects. It is indeed a miracle of enterprize for any man, or set of men, to undertake so gigantic an experiment on little more than mere theory. Yes, it is a triumph, and a grand one; one of which our whole country must ever feel proud.

During the trip down the bay an excellent repast was served, a breakfast, to which full justice was done. On the return, Captain Ericsson very lucidly explained, with a working model and diagram, the operation of the engines, and satisfactorily replied to all the objections raised by the company, as to the working of its different parts. During these explanations the deepest interest was manifested by all present, and none failed to understand fully the whole subject.

After this a meeting was organized, H. J. Raymond, esq., in the

chair, and a committee appointed to draft resolutions. Many excellent and timely remarks were made by Messrs. Raymond, Stoughton, (the legal counsel, and on this occasion the representative of the proprietors of the vessel,) Erastus Brooks, Professor Mapes, Dr. Jones, and others, after which the following resolutions, presented by the committee appointed for the purpose, were adopted. [See pages 9 and 10 *ante*.]

From the New York Herald.

THE CALORIC SHIP ERICSSON.

Successful trial trip—General description of the Ship—Another great commercial enterprise.

In the great commercial and shipping circles of the world nothing has excited more interest of late than the novel discovery and enterprise of Captain Ericsson, by which steam, as a motive power, is to be supplanted by caloric, or heated air ; and nothing but the successful application of the actual test could remove the skepticism with which, generally, the project has been viewed. This test has, however, at length been furnished, and now all doubts of the practicability and importance of the invention are dispelled. The ship Ericsson, constructed on the new principle, made her trial trip, on Tuesday morning, down the bay of New York, and from the complete triumph with which the experiment was attended, there need now be no hesitation in acknowledging caloric as a great natural element adapted to locomotion, destined to work a complete revolution in navigation, and to confer an inestimable benefit on mankind.

The Ericsson was put under caloric early on Tuesday morning, and started from Williamsburg between 9 and 10 o'clock. At 9 h. 55 m. she passed the flagstaff on Governor's Island, and at 10 h. 36 m. and 30 seconds she was abreast Fort Diamond, *thus making a distance of seven and three-eighths miles in thirty-four minutes and thirty seconds*. From thence she proceeded down the bay, rounded to below Spithead buoy at 11 h. 21 m., and there anchored in consequence of a snow squall. She returned on Wednesday, and anchored off the Battery at 2 o'clock in the afternoon. The distance between the stated points on Governor's Island and Fort Diamond being accurately known by triangulation to be seven miles six hundred and sixty yards, the speed attained was as stated about fourteen miles an hour. *The consumption of fuel is ascertained to be only six English tons per twenty-four hours, a saving, as compared with steamships, of more than eighty per cent.* As the ship draws 16 feet 10 inches on an even keel, this performance at a first trial has astonished all concerned in the enterprise.

The great idea which had for more than twenty years been ripening in the brain of the inventor, but which, from the incredulity and opposition he encountered among men of capital in his own native country,

in England, and in America, he had been unable to realize, has thus been substantiated as a real entity. It was fortunate for Captain Ericsson, and for the world, that one of our own enterprising merchants, John B. Kitching, esq., who appreciated and relied on his talent and genius, determined at all risks to enable him to make the experiment on a scale worthy of the magnitude of the issue. For this purpose the latter furnished half of the capital necessary for the enterprise, and disposed among his acquaintances of the remainder of the stock. By this means, and regardless of expense, the clipper ship, whose first performance we have recorded, was built at the yard of Perrine, Patterson & Stack, and fitted up with enginery on the caloric principle, under the immediate direction and supervision of Captain Ericsson. The vessel measures 260 feet in length of deck, and 40 feet in breadth of beam; her depth of hold is 27 feet, and her burden 2,200 tons. Like the Arabia, of the Cunard line, she has but two masts, and like our swiftest clippers, she is extremely sharp in the prow. She has no figure-head. Her stern presents the device of two figures, allegorical representations of the United States and Great Britain placing a wreath around the brow of the inventor. She had been originally named the Caloric, but in compliment to the genius who planned her, her name was changed to the Ericsson. This was considered by Captain Ericsson a high tribute to himself, but the flattering device which was placed upon the stern without his knowledge overwhelmed him with emotion, and we are told that when he first saw it he wept like a child. The Ericsson presents a very handsome and unique appearance, from the four white funnels which rise some ten or twelve feet over the promenade deck, and which somewhat resemble Ionic pillars without the capital. They are thirty inches in diameter, and are supported by octagon pedestals, also white. Two of these columns, or pipes, carry off the air from the engine, and the other two serve as chimneys. Around their tops they are ornamented with gilt rings and mouldings. These gilt ornaments are now, after ten days' firing, perfectly bright. Entering the spar-deck, the absence of any crank hatches, and a clear deck for two hundred feet on each side of the deck-house, attract the eye. The berth-deck likewise presents an unbroken line, with state-rooms along the entire ship, and passages between the fore and aft saloons on both sides.

As a model of naval architecture, there is not a vessel in our splendid merchant marine that can compete with the Ericsson for graceful proportions and symmetry of build. All who have seen her concur in the expression of admiration of this beautiful ship, and in their opinion of her superior sailing qualities, independent of any aid from her machinery.

For obvious reasons, those interested in the undertaking have observed great caution and jealousy to prevent any knowledge of the construction of her machinery, &c., from getting abroad. To guard against this, portions of it were made at various places—New York, Philadelphia, West Point, &c.—from plans and specifications furnished

by the inventor. So perfect and true were his calculations, that every piece of the machinery thus made fitted in with the utmost exactitude, so that, to give the language of one of the persons engaged in it, a sheet of tissue paper could not be put in between the joints. This circumstance, in itself, speaks well for the great engineering skill of its constructor. The same jealous caution was observed in permitting strangers on board. The exclusion of all outsiders has been very rigidly enforced, so that the hundreds whose curiosity brought them to visit her were forced to content themselves with a distant inspection. Thus, up to the present time, no correct description of her has appeared in type; and we therefore feel confident that that which we now present to our readers in relation to this remarkable vessel, will be read with an interest proportionate to the invention, of which the Ericsson is the first embodiment.

Let the reader, therefore, accompany us as we are chaperoned throughout the ship by her gallant and polite commander, Capt. A. B. Lowber, to whose ability and experience as a navigator she has been well confided.

Let me first show you, says our guide, the freight deck, and then we will ascend and examine her in detail. To the freight deck, therefore, we descended, and were pointed out its capacity, extending as it does some 260 feet. It is entirely free from obstruction of every kind, excepting only a space along the middle, which contains the cylinders, enclosed within strong bulkheads. None of its room is to be devoted, as in steamers, to the carrying of coal, which is stowed away in sufficient quantity each side of the engine. It is calculated thus to carry 1,400 tons of teas, or other light merchandise; or, if engaged in the Australia or California trade, it is well adapted for accommodating some four or five hundred passengers. A ventilator on a new principle, and connected with the machinery, extends to this deck. About midships there is a sort of square enclosure, which, we learned, communicated only with the main deck, and which has been fitted up for the female servants of cabin passengers. This is a great improvement on the present plan, which makes little or no provision for this class of travellers. We found this room neatly and comfortably furnished, with twelve or fourteen berths, and conveniences for bandboxes and the various et ceteras of waiting women.

From the freight deck we ascend by a wide stairway to the main deck. This is occupied from stem to stern by sixty state rooms; those in the aft cabin fitted up with two berths each, and those in the forward cabin with three. We inspected the latter portion first, and were struck with the elegance and taste with which it was fitted up. We were immediately reminded of the motto, which we saw in a conspicuous position on the board, "everything in its place, and a place for everything," and we felt the conviction that this maxim was not lost sight of in the construction and fitting up of the ship. The state rooms communicate direct with the saloon by a gothic arched door, which opens on every two rooms. They are richly carpeted, and are lighted by day with deck and side lights, and by night with a three-sided lamp,

so fitted in the panelling as to furnish a light at the same time to two rooms and the saloon. These lamps are provided with a lock, and are to be in charge of one of the employées. The berths are handsomely fitted up; the mattresses are composed of the best curled hair; and the bed clothes are also of the whitest and finest texture, and marked with the word Ericsson in red letters. A marble slab wash basin and appurtenances belong to each room; and on the side opposite the berths is a sort of day sofa, which answers the very necessary use of a receptacle for soiled clothes and boots. A small bronzed framed mirror, with a pivot which permits it to be turned in every direction, completes the furniture of these apartments. We must not forget to mention that a fine room is also fitted up here for the accommodation of the waiters connected with the vessel, who are obliged on other ships to stow themselves away under the tables and elsewhere. Fourteen double berths are provided for them, and all the conveniences of water pipes, wash basins, mirrors, &c.

The forward cabin saloon is very handsomely furnished, and presents a chaste appearance, from the gothic style of the doors which open into the state rooms, and from its general decorations. The chairs and sofas are covered with crimson plush, and are of the neatest pattern. The carpets are of a very rich and beautiful material, the design representing the American flag interspersed with forest foliage, &c. The panels are painted white, shaded with a light tinge of purple, and decorated with gilding. The device round the cornices, on raised gilded work, represents Neptune in his chariot, drawn by sea monsters. In fact, the only point of distinction between the aft and forward cabins is, that the rooms of the latter are fitted up with an extra berth; and if it were judged advisable to have a uniformity of price for passage, the plan could be easily carried into execution, it being only requisite to take away the third berth from each of the forward cabin state rooms. For the saloon, there is a steward's pantry amidships, provided with neat delph, glass, cutlery, &c., and communicating by a dumb waiter with the kitchen.

The state rooms of the after cabin, which is merely separated from the other by passage doors, are in no respect different, except in the numbers of berths, from those we have just described. They range along each side of the deck, the central space being occupied with the machinery, to which several doors admit an entrance. These doors have a circular pane of glass, to allow passengers to witness the working of the machinery. A barber shop is fitted up in the state room through which the shaft runs, the corresponding room on the opposite side being used as a storeroom. The saloon is larger, and furnished perhaps in a more expensive style, than the forward cabin, but the character of the furniture and fittings is precisely the same. This saloon is heated by a hot air apparatus, and ventilated by the same means as is the freight deck, except that here the ventilator is shut in by a stained glass frame. Hot and cold air can be supplied to any part of the vessel from the engine. The peculiar construction of the

ship, and comparatively small room occupied by the machinery, afford an inner promenade round the whole course of the cabins, extending some five hundred feet. On the upper deck the space between the cabins and the side of the vessel is some twelve feet wide, extending also round the ship.

The ladies' boudoir in the after cabin is a handsome semi-circular apartment, furnished with great elegance, and richly carpeted. It is entered from the main saloon by two doors, on opposite sides; round the bend of the room a sofa is arranged, with a marble slab table in front of it. There are besides in the room several ottomans and luxurious arm chairs, covered with rich crimson plush, and the walls are ornamented with mirrors. There is also a neat library fitted up in this room, with mirror doors, the lower part of it being reserved for a medicine chest. The apartment is one of the most chaste and elegant we have ever seen assigned to the purpose of a ship.

From the main cabin there are four stairways to the upper deck. Here is the dining hall for the aft cabin passengers. This is a fine well lighted room, painted in imitation of oak, having mirrors and windows in each alternate section of panels. There are several book-cases in the room, which is also supplied with comfortable sofas. Leading from it forward, we come upon a small circular apartment, containing a glass case for the ship's plate, &c., and here, also, is the main pantry, a room for the storekeeper to issue wine, and a water-tank with filter, capable of holding one hundred and five gallons. The remainder of this deck, forward, is occupied in kitchen, steward's rooms, officers' mess, &c.; and aft is a smoking room for the first cabin passengers, with a fine comfortable wheel-house, in which is a place for stowing ammunition, &c.

One of the greatest peculiarities in the fitting up of this ship is the absence of all angularities, and one cannot but admire the skill with which every available spot is adapted to the best use, while all arrangements are of the most regular kind. Nor in the attention to the comfort of the passengers has the comfort and well being of the sailors and firemen been overlooked; the forecastle is neatly fitted up with berths, water pipes, basins, mirrors, library, &c., and on the larboard side the like accommodations have been provided for the firemen.

Having arrived thus far in our gratifying inspection of the Ericsson, we were led to that portion assigned to the machinery. This part is characterized by the same neatness, and exhibits the same proofs of superior skill and management, as are observable throughout every other part of it. Apart from the main principle, the distinguishing feature of the engines of the Ericsson consists in dispensing with the centre shaft, whilst at the same time two pairs of working cylinders are employed, imparting a continuous rotary movement, as in the double marine steam engine. The arrangement by which Captain Ericsson attains this desirable uniform action presents one of the most elegant mechanical combinations ever produced. Each pair of working cylinders, with their appropriate supply cylinders, are placed parallel to the ship's cen-

tre line; one pair forward of, and the other abaft, the paddle shaft. The supply cylinders being inverted and placed at some distance above the working cylinders, with their open ends presented to the open ends of the working cylinders, a space is formed between the two, which contains a triangular lever for transmitting the vertical energy of the working pistons to the crank of the paddle shaft by a diagonal movement. The mean angle of their diagonal being about forty-five degrees abaft the vertical plane of the paddle shaft in the aft engine, and forty-five degrees forward of that place in the forward engine, it is obvious that the forces of the two engines will be exerted nearly at right angles to each other. Hence the double cranks, and the objectionable centre shaft of the marine steam engine, are obviated; a single crank placed in the middle of the caloric ship serving to transmit, in a perfect manner, the continuous rotary motion required in turning paddle wheels for ocean purposes. In further comparing the machinery of the Ericsson with the double marine steam engine, it will be found that the four side levers have disappeared; the cross heads and cross tails likewise; nor are the four side rods to be found; and, above all, the absence of the parallel motion, with their nicely-adjusted joints and levers for converting the curved movements into straight ones, claim attention. In place of all these parts will be found simply a triangular lever for each engine, with a link and connecting rod for transmitting the power of the pistons to the crank of the paddle shaft. Again, the four huge boilers of the ocean steamer give place to four small furnaces, erected under the working cylinders. Force-pumps, brine-pump, safety-valves, &c., and the network of connecting pipes, which fill the bottom of the ocean steamer, have all disappeared; and in place of gauge-cocks, brine-gauges, injection valves, &c., &c., calling for incessant vigilance on the part of many minds and hands at once, a single handle attached to the valve gear of the engines regulates at the will of a single mind the movements of a caloric ship. Starting, stopping, backing, and checking being effected by this single handle, without any regard to particular conditions, so essential in working the engines of the ocean steamer. The arrangement of the caloric ship being such that the required air for the engines—from 50 to 70 tons weight per hour—has to pass through the fire rooms before entering the supply cylinders, it has been found in the Ericsson that the temperature is actually too low for the comfort of the firemen.

As an engineering achievement, the machinery of the Ericsson is very far ahead of anything afloat. The engineer, who beholds four open cylinders, each of 168 inches in diameter, with their pistons of upwards of twenty-two thousand superficial inches area, moving up and down in sight, through a space of six feet, can best appreciate the greatness of that achievement. To the ordinary observer, the movement of the whole machine is wonderful. And we cannot but feel extremely gratified that the caloric principle was introduced to the world on a scale so commensurate with its importance, and that our metropolis has the honor of initiating it.